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Global biodiversity

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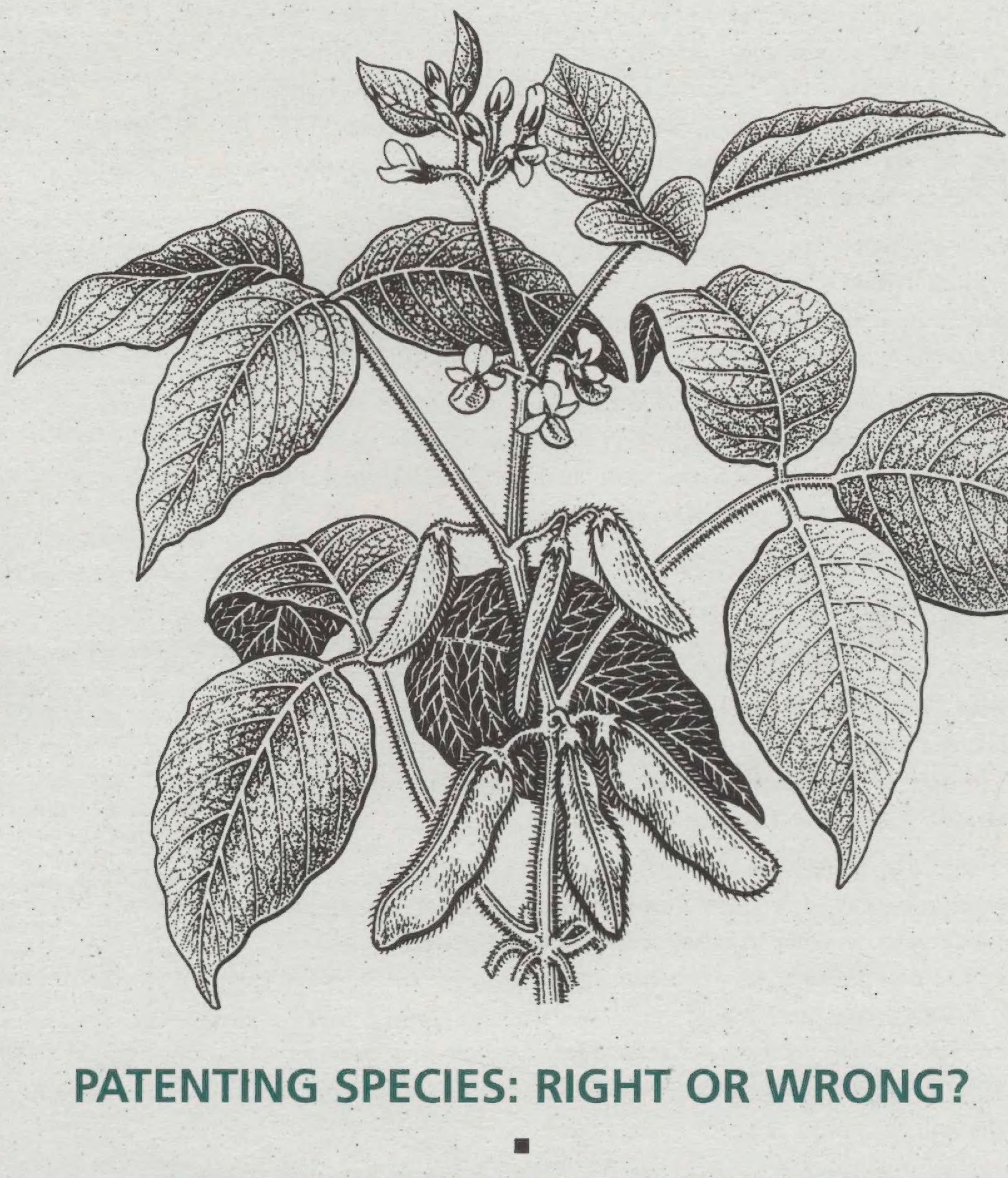

PATENTING SPECIES: RIGHT OR WRONG?

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GAPS IN FRESHWATER RESEARCH

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EDITOR'S NOTEBOOK

Ice and fire storms: The Kyoto deal

The worst recorded ice storm swept eastern Canada from 5–8 January 1998. Two centimetres of ice encased twigs, burdening trees with thousands of kilograms of ice. Birch and cedar trees doubled over to meet the ground. With cracks that rang out like gunfire, branches snapped, entire trees broke. The ice storm swept over more than 100,000 km^2 of land and, by my crude calculations, the equivalent of 10,000 km^2 of forest was lost or will subsequently die.

Can this ice storm be attributed to climate warming? Climate is the average weather over a given period, so it is difficult to attribute individual weather events to climate change. Under climate warming models, however, the number of storms and winter temperatures are both expected to increase.

With Canadian forest fires we are on firmer ground; we have data spanning several years. Average annual losses due to forest fires have doubled in the 1990s; 11,000 km^2 more forest was lost per year in the 1990s than the 1980s. This increase has been associated with climate warming (Canada Year Book 1997).

Not including other benefits of forest biodiversity, forest fibre products (derived from clear-cutting about 9,000 km^2) yielded $49 billion in economic activity (Canada Year Book 1997). So the ice storm will cost about $50 billion in estimated economic activity and each year in the 1990s forest fire increases will cost an equal amount. A prime contributor to greenhouse gases, which are believed to be fueling the trend towards climate warming, is the burning of petroleum products that generate carbon dioxide. In 1994, Canadian crude oil, natural gas, and natural gas by-products generated $23.5 billion (Canada Year Book 1997).

Looking at the two sources of revenue side by side raises a number of questions. Would it be economically wiser to decrease petroleum usage (and thus reduce the severity of natural disasters) in order to foster savings in forest-product and other industries? Would a carbon tax levied on petroleum products provide the incentive to reduce carbon dioxide production? Should the Canadian government have been more aggressive in Kyoto when pursuing lowered greenhouse gas emissions, following the European lead (15% cut), rather than the American proposal (6%)? What do you think?

Don E. McAllister

Don E. McAllister
Editor

Editor:
DON E. McALLISTER, Ph.D.
Associate Editors:
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Design and Layout: Nicole Dupuis
Illustration: Roelof Idema

Business Manager: Dory Cameron
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Anne Winship
Subscription Manager: Susan Swan
Promotion and Advertising Coordinators:
Mailin Boppe, Cate Kempton

Editorial Submissions
Catherine Ripley, Managing Editor
Global biodiversity
Canadian Museum of Nature
PO Box 3443, Station D
Ottawa, ON K1P 6P4
Tel: (613) 566-4267
Fax: (613) 566-4763
cripley@mus-nature.ca

Advertising Sales
Anne Winship
Tel: (613) 566-4203 Fax: (613) 566-4763
awinship@mus-nature.ca

Subscription Sales
Susan Swan
Tel: (613) 566-4784 or 1-888-437-6287
Fax: (613) 566-4763
sswan@mus-nature.ca

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Cover illustration Soybean *(Glycine max* L.*)*
Illus.: Roelof Idema

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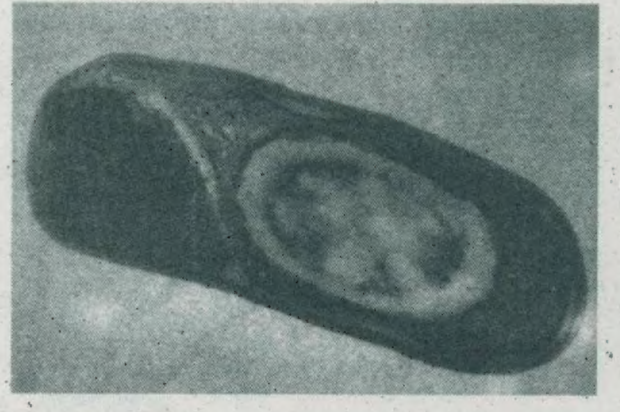
Patenting life: Progress or piracy?

Patents can lead to billion-dollar returns at the same time as loss of rights for smaller farmers and indigenous peoples.

Genetic Resources Action International



Bt gene
Photo: Jean-Louis Schwartz

Around the world, governments, corporations, indigenous peoples, and individuals are discussing the patenting of biodiversity. At stake for corporations is billions of dollars in additional income and, more importantly, legal control over the basic technologies and resources of our food supply and health care systems. At stake for global society is a wide range of ethical, economic, and political concerns revolving around one central question: is it right that corporations own the biological underpinnings of life?

Plants are a case in point: 70% of our food supply comes from a few plants (wheat, maize, rice, potato). Plants are also integral to many medicines and lie at the root of health care systems. Biotechnology corporations and researchers are trying to claim individual or even blanket ownership of "genes" and "plants." But how can genes be new? How can you invent a plant or own a species? What about those that developed the desired traits in the first place? And perhaps most important: what does it mean for farmers and for local, national, and global food security? By examining five patents already granted in some parts of the world, the profound and wide-ranging implications for society start to become clear.

Bt GENE A naturally-occurring soil bacterium called *Bacillus thuringiensis* (*Bt*) produces a protein that kills a range of common insects once it is ingested. Because of this, *Bt* has been used as a biological pesticide for crops by farmers since the 1940s. Due to the severe ecological consequences associated with synthetic chemical pesticides, the environmental friendliness of *Bt* has caught the attention and investments of several large agrochemical companies. Biotechnologists have isolated a *Bt* gene and inserted it directly into a range of crops, including maize, soybean, cotton, rapeseed, potato, tobacco, rice, and tomato, so that these plants can produce their own insecticide.

As of March 1996, there were no less than 432 patents granted or pending worldwide related to *Bt*. Sixty percent of these belong to ten companies, which means the technology is heavily concentrated in few hands. *Bt*-maize, *Bt*-cotton, and *Bt*-potato have all received patent approval in the U.S. In Europe, the approval of Novartis's *Bt*-maize has been stalled because of the presence of a marker gene that codes for antibiotic resistance. If animals — or people! — consume this gene through *Bt*-maize-based products, such as cattle feed or starch, some antibiotics would become ineffective as a medicine (Cohglan 1996).

Companies are at each others' legal throats over who really owns what. For instance, Belgium's Plant Genetic Systems (a biotechnology company now

Genetic Resources Action International, GRAIN, Girona 25, pral 08010 Barcelona, Spain; Tel: (34 3) 301 13 81; Fax: (34 3) 301 16 27; E-mail: <grain@bcn.servicom.es>

GRAIN is an international non-governmental organization (NGO) that promotes the sustainable management and use of agricultural biodiversity based on people's control over genetic resources and local knowledge, with a special emphasis on developing countries.

Soybean
(Glycine max L.*)*
Illus.: Roelof Idema

owned by the giant AgrEvo) has been granted a U.S. patent for "all transgenic plants containing *Bt*," and the American company, Mycogen, has been issued a European patent that covers the insertion of "any insecticidal gene in any plant." (A transgenic organism is an organism into whose genome at least a copy of one gene or group of genes has been inserted, by means of genetic engineering.) Such broad patents confer huge market power to the company that wins, while blocking anyone else who wants to work further in this area.

Patenting soybeans, a basic item in the world's larder, gives enormous control to the patent owner.

As a technology, *Bt* crops carry many threats. The insects that are supposed to die once they chew on a *Bt* plant can develop resistance to the toxic gene extremely quickly. For example, experiments conducted at the University of Hawaii have shown that insects that survive *Bt* transmit genetic resistance to their immediate offspring. In one generation, insects become resistant to many forms of the toxin, rendering *Bt* useless as an implanted pest control strategy (Beard 1997). Worse, it means organic farmers will not be able to use *Bt* as a spray any more, since conventional farmers using transgenic *Bt* crops will have destroyed its effectiveness. Traditionally, insect resistance to *Bt* was not a problem. Organic farmers did not use *Bt* intensively, so the spray had little environmental permanence. Also, because it was known to be toxic for water life, it has always been used with caution.

Being able to patent *Bt* genes and crops encourages the development of *Bt* crops. Biotechnology companies will thus be able to make quick money by convincing farmers to buy seeds that supposedly do not need insecticidal sprays. The potential market is huge and companies have quickly cornered it. In the U.S., legal wrangles over ownership of *Bt* technology are consuming vast amounts of time and money among many of the leading agrochemical companies. This time and money could be spent developing alternatives to a technology that is likely to fail. Rather than promote innovation, the patent system applied to life seems to foster the pirating of proven technologies and the wasting of resources. The livelihoods of thousands of farmers and the consumer's right to choose are also at stake. For instance, at present the European Union does not require the labelling of products containing Ciba's Bt-maize, although it plans to do so at some point in the future. There is a large controversy within the EU as to what products will be labelled: the intention of the European Commission to market only those products that contain raw protein from the maize has been rejected. Such labelling would not have included, *inter alia*, maize oil or high fructose syrup, which could be widely used in food products.

SOYBEAN Soybean (*Glycine max* L.) is a multi-billion dollar commodity crop. It was domesticated by the Chinese as a food crop and is now an important oil crop as well as a crop grown for animal feed. Today, the top soybean producers are the U.S., Brazil, China, and Argentina, with the U.S. cornering well over half of the global export market. While still an important vegetable and protein crop for Asians, soybean now ends up in unfathomable industrial products — from the ink in your daily newspaper to the ketchup on every fast-food outlet's hamburger. Patent rights over the world's soybean crop would mean enormous economic, social, and political control over a basic item in the world economy.

In 1994, the biotechnology company Agracetus was awarded European patent number 301 749. This patent

Adapted from *Patenting, piracy and perverted promises. The European patent directive: The last assault on the commons* published by GRAIN, Summer 1997.

The historic local diversity of quinoa will erode if Bolivian farmers plant only a few hybrid varieties.

Quinoa
(Chenopodium quinoa)
Illus.: Roelof Idema

claims, among other things, "a soybean seed which will yield upon cultivation a soybean plant comprising in its genome a foreign gene effective to cause the expression of a foreign gene product in the cells of the soybean plant." This means that Agracetus's patent covers all transgenic soybeans.

The biotechnology industry was stunned by the patent, which underwent fire in the courts. The chemical giant Monsanto opposed the patent in November 1994 on the grounds that, "the alleged invention lacks an inventive step" and was "not...novel." But later Monsanto simply bought up Agracetus — including the patent — and stopped complaining.

Species patents, such as this one on soybean and others on cotton and rice, show how the patent system itself is being grossly distorted by unbridled corporate greed. Transgenic species do not exist as such, and technologies have to find their expression in specific terms, such as well-defined varieties that farmers grow in well-defined conditions. The soybean patent is an example of a patent being used as a means to block research and competition by staking territorial claims with no relation to invention.

In addition, in those countries where the patents are recognized, farmers have to follow stringent rules when using transgenic soybeans. For example, in the U.S., soybean farmers have already been subjected to this kind of contract when they choose to grow Monsanto's "Roundup Ready Soybeans." In purchasing the patented seed, farmers agree to only use Monsanto's herbicide on the crop, not save a single seed to save costs for the next season — as is traditionally done — and not conduct any research using the soybean. Monsanto is either pursuing or has reached out-of-court agreements with more than 100 soybean growers that have saved and replanted Monsanto Roundup Ready soybean (Hillyer 1998). Monsanto takes this issue very seriously.

QUINOA Quinoa (*Chenopodium quinoa*) is a high-protein cereal that is an important part of the diet of millions of people in the Andean countries of Latin America, especially indigenous people. Since pre-Incan times, they have cultivated and developed varieties of quinoa that can survive the wide range of harsh conditions in the Andes. In recent years, quinoa has started to enter the markets in Europe and the U.S. and is known for its high nutritional value — about twice the protein content of maize or rice. The value of Bolivia's export market is estimated at about U.S. $1 million per annum.

In 1994, two researchers from the University of Colorado received U.S. patent number 5,304,718, which gives them exclusive monopoly control of male sterile plants of the traditional Bolivian "Apelawa" quinoa variety. The researchers admit that they did nothing to create the male sterile variety. One researcher agrees that it was "just part of the native population of plants...we just picked it up." They do claim that they were the first to identify and use a reliable system of cytoplasmic male sterility in quinoa for the production of hybrids (RAFI 1996). The U.S. patent claim is not limited to a single hybrid variety, but covers any quinoa hybrid that is derived from "Apelawa" male sterile cytoplasm, including, but not limited to, some 36 traditional varieties cited in the patent application.

Although the researchers have promised to make the technology available to researchers in Chile and Bolivia, the U.S. patent has serious implications for Bolivian farmers. The primary aim of developing hybrid quinoa is to increase the crop's yield and to make it suitable for commercial-scale cultivation in North America. Before long the patent is likely to find its way into corporate hands, where the right that the patent owners have to prevent Bolivian exports of quinoa to the U.S. will probably be exercised. The displacement of Bolivia's export market would undermine the livelihoods of the

The production of a transgenic brazzein could eliminate the collection or commercial planting of it in West Africa.

thousands of farmers who grow quinoa, who are predominantly small-holders. These actions would counter the benefit-sharing clauses of the International Convention on Biological Diversity (CBD), which Bolivia and 168 other nations have ratified — but not the U.S. Even the CBD provisions, however, do not compensate for the fact that a patent on this plant is an undue monopoly of a part of the commons.

Alternatively, Bolivian farmers may be pressured to grow the industrial high-yielding varieties for export. If they start planting a handful of hybrid varieties instead of the diverse array they now grow, there will likely be serious erosion of local quinoa diversity. In addition, the high-yielding varieties may well not be adapted to local conditions.

BRAZZEIN Brazzein is the name of a protein found in a West African berry that is reported to be 500 times sweeter than sugar. Unlike other non-sugar sweeteners, brazzein is a natural substance and does not lose its sweet taste when heated, making it particularly valuable to the food industry. The sweetener was happened upon by a researcher after he observed people and animals eating the berries in West Africa.

Researchers at the University of Wisconsin have received U.S. patent 5,527,555 and European patent 684995 for a protein isolated from the berry of *Pentadiplandra brazzeana.* Subsequent work has focused on making transgenic organisms to produce brazzein in the laboratory, thereby eliminating the need for it to be collected or grown commercially in West Africa.

The University of Wisconsin reports that corporate interest in brazzein is strong: the worldwide market for sweeteners is reported to be $100 billion a year. The university is quite clear that brazzein is "an invention of a UW-Madison researcher" and there are no plans for benefit-sharing with the West African people that discovered and nurtured the plant for their original pleasure. This is a clear example of how the patent system completely disregards local knowledge and innovation of people in developing countries by permitting biotechnologists to claim that something was invented once it was isolated and reproduced in a laboratory in a developed country. By allowing patents on discoveries, the redefined patent system promotes what Third World countries rightly call biopiracy.

SANGRE DE DRAGO Sangre de Drago (*Croton* spp.) is a medicinal plant widely known and used throughout the Amazonian region for healing wounds, haemorrhoids, skin problems, and as an anti-inflammatory and anti-rheumatic agent.

Shaman Pharmaceuticals, a U.S. company that prides itself on its progressive stance towards local peoples and biological resources, has developed two Sangre de Drago-derived products: Provir7, an anti-diarrhoeal; and

Sangre de Drago
(*Croton* spp.)
Illus.: Roelof Idema

Patents often privatize a collective knowledge held widely by indigenous peoples.

VirendJ, an anti-herpetic. Both are in clinical trials. A patent for anti-viral activity has already been awarded to the company (U.S. 5,211,944). Because Shaman's policy is to provide returns to the communities it collects from, it argues that the development of new medicines from wild biodiversity and local ethnobotanical knowledge will not only benefit the company, but will also aid biodiversity conservation and improve the quality of life of indigenous peoples (Reyes 1996).

The Sangre de Drago case parades as an equitable benefit-sharing agreement. The resources are extracted, the knowledge is lifted, the results are patented — but at least the locals get a share of the profits in return. These deals sound good on paper, but have so far yielded little, if any, benefit for local communities.

In its publications, Shaman acknowledges the importance of crediting the "intellectual property rights" of communities, yet Sangre de Drago products are patented in the U.S. under the company's sole name. The real issue, however, is that patents like this one privatize and individualize a collective knowledge widely held by many indigenous peoples in different parts of Latin America.

CONCLUSION The patent system, and other forms of intellectual property rights, is supposed to stimulate innovation. By giving inventors a monopoly on their creations, governments provide incentives for innovation. By allowing such incentives for a period of time, society is supposed to get the disclosure of the invention and the technological progress in return. But is the system working, and should it be applied to living species? Should farmers need to get a license to grow crops? Should people see their body parts patented? Should the legal concept of western intellectual property rights be enlarged to include traditional ecological knowledge (TEK), experience, and discoveries? TEK is, by nature, collective — based on the free exchange of knowledge and biodiversity. In contrast, intellectual property rights of any kind are, by definition, a limitation of this knowledge flow and collective nature, and thus are against the very nature of TEK, its development, and even its survival. Should corporations or scientists in the developed world get ownership rights over indigenous peoples' traditional knowledge, crops, and medicines? This is what is happening today.

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Using crop residues to save forests

When leftover straw is used to make pulp, the need for trees is greatly reduced.

Al Wong

In the 1990s there has been renewed public interest in paper products that are made from agricultural-fibre pulp. Reasons for this interest include a desire to preserve natural forests, to eliminate air pollution from burning straw, to develop new economical fibre sources, to increase rural economic development, and to reduce farm subsidies.

For more than 100 years, the North American production of paper from agricultural fibres has been very limited. Approximately 250,000 tonnes are produced annually, about 1% of total pulp production in North America. The main agricultural-fibre grades consist of cotton pulp for specialty printing and writing paper, flax pulp for cigarette paper, and abaca pulp for tea bag and other filter papers.

Agri-pulp is defined as papermaking pulp made from annual plant fibres. Hybrid poplar and bamboo are excluded from this definition because their growing-harvesting cycle is not annual; the typical rotation cycle is 3 to 15 years (Gascoigne 1988; Arnold 1995).

Agri-pulp can be manufactured using the same methods as those used for wood pulp. However, due to the physical make-up of agricultural fibres, simpler pulping and bleaching approaches could be applied to agricultural fibre with greater efficiency and economy (Folke 1984; Wong 1992; 1995; 1997). Paper is an engineered product, and Figure 1 shows the multiplicity of choices that exist in making a hypothetical piece of paper. With six types of fibre, four pulping methods, three bleaching methods, nine preparation methods, and two papermaking techniques, there are 1,296 ways to make one final sheet of paper!

Agri-fibre pulp for papermaking must be used in conjunction with other environmentally clean manufacturing technologies. Overall, the technical competitiveness of agri-pulp should be very good because there is a wide variety of fibre types (e.g. morphology and chemistry) that can be selected for the manufacture of high-performance paper products.

ON-PURPOSE CROPPING OF AGRI-RESIDUES? Fibre for agri-pulp production could come from agricultural crops that are grown on purpose for fibre or from fibre residues from crops that are grown for food. Virtually any agricultural fibres can be used for papermaking. This paper discusses the use of cropping residues to supply some of the fibre for papermaking.

On-purpose fibre cropping is similar in practice to classical tree plantations with land set aside for non-food uses. Kenaf, hemp, and switch grass are examples of crops grown strictly for fibre needs. Large-scale cultivation of

Al Wong, Arbokem Inc., P.O. Box 95014, South Vancouver, CSC, Vancouver, BC, Canada V6P 6V4, Tel: (604) 322-1317, Fax: (604) 322-5865; E-mail: <info@agripulp.com>

Figure 1.

MULTIPLICITY OF CHOICES IN PAPERMAKING

In this example, there are 1,296 possibilities for one final sheet of paper!

Six FIBRE types

(examples: hardwood, softwood, cereal straw, flax, hemp, sisal, mixed office wastepaper, old newspaper, old corrugated boxes)

↓

Four PULPING methods

(examples: kraft, sulphite, soda, thermomechanical, chemi-thermomechanical)

↓

Three BLEACHING methods

(examples: hyrdrogen peroxide, chlorine, ozone, chlorine dioxide etc.)

↓

Nine PULP PREPARATION methods

(examples: clay, calcium carbonate, titanium dioxide, etc; rosin size, acidic pH, alkaline pH, synthetic size, filler retention, etc.; fibre fibrillation, fibre shortening, etc.; optical brighteners, etc.)

↓

Two PAPERMAKING methods

(example: heavy calendering to reduce caliper, which also affects sheet opacity and smoothness)

↓

One FINISHED PAPER

these fibre crops for papermaking is uncertain and expensive, and "large-scale" plantations would be needed to produce an adequate supply of these fibres to fit the existing template of the wood pulp mill industry.

As with tree fibre crops, annual fibre crops also demand herbicides, insecticides and fertilizers. Table 1 illustrates that fibre crops require more nitrogen fertilizer than tree plantation crops. The actual amounts used vary somewhat from region to region.

Hemp has been suggested as a means to solve the expected fibre shortage in North America. How does a hemp plantation compare with a pine plantation? Here are some calculations based on the premise of replacing original disturbed forest in the southern U.S. with either a pine plantation or a hemp plantation. On the assumption that the whole hemp stalk would be used for pulp-and-paper production, the hypothetical hemp plantation (under continuous cropping practices) could yield almost two times more fibre over a 15-year period than the pine plantation. Under intensive management practices, the pine plantation could yield about 15 m^3 of commercial wood per hectare per year, with a rotation cycle of 15 years (Arnold 1995; Breck 1987).

Adapted from a paper presented at Fiber Futures '97 Conference, Monterey, California, 2 June 1997. The original document is available at <http://www.agripulp.com/ar07/ar07_1.htm>

The 15-year yield calculation was made as follows:

Hemp plantation

$$\frac{\text{13 tonnes whole stalk}}{\text{year per hectare}} \times \text{15 one-year cycle = 195 tonnes, dry basis}$$

Pine plantation

$$\frac{\text{15 cubic metres bole}}{\text{year per hectare}} \times \frac{\text{500 kg dry}}{\text{green cubic metres for Loblolly pine}} \times \text{one 15-year cycle = 113 t} \quad \text{dry b}$$

However, the use of whole hemp stalk for the production of fine paper is not well established. Thus, if only the hemp bast fibre is used, then the hemp fibre plantation would yield only 58% of the quantity of fibre that the model pine plantation would (Wong and Chiu 1995).

Would hemp cultivation be able to meet the paper industry's fibre demand? In 1996 about 28 million tonnes of printing and writing paper was produced in North America, which required an estimated 50 million tonnes of wood fibre. If whole hemp stalk is assumed to be suitable for the manufacture of pulp for printing and

Table 1. Nitrogen fertilizer demand of selected fibre crops

FIBRE CROPS	EXAMPLE OF ANNUAL DEMAND OF NITROGEN (N) FERTILIZER (IN KG PER HECTARE)
Hemp (Eastern Canada); Anon. 1994	102
Kenaf (California;17–23 tonnes stem/ha); Bhangoo et al 1991	140
Cotton (California); Martin et al 1976	144
Hybrid aspen (Northern U.S.); Einspehr and Hychoff 1975	40 typical
Loblolly pine (Southern U.S.); Armson 1977	15–20 typical
FOOD CROPS	
Wheat (Western Canada; 2 tonnes grain/ha); Anon. 1994	42
Corn (Eastern Canada; 3 tonnes grain/ha); Anon. 1994	48

writing paper grades, then about 4 million hectares (about 10 million acres) would be required for hemp cultivation. It is interesting to note that the "4 million hectares set aside for hemp cultivation" would represent about 12% of the wheat growing land in North America. The "apparent loss" of food grain production could be as much as 10 million tonnes! The moral question is whether to use agricultural land primarily for growing food or fibres.

Using agricultural residues to meet papermaking fibre demands is a better alternative. Food grain production provides both food and fibre on the same hectare of land. No new allocation of land for cropping is required. No additional fertilizers, herbicides, or pesticides are needed. To best maintain the quality, structure, and biota of the soil, using agricultural cropping residues (i.e. straw) for pulp-and-paper production should follow strict soil conservation practices. The crop variety grown, local climate, soil conditions, and cultivation practices will determine what amount of straw can be removed permanently from the land for non-agricultural purposes (Stumborg 1995). Cereal straw produces the most abundant agricultural cropping residue in North America. There is no accurate inventory of straw supply in Canada or the United States. Fortuitously, straw availability can be estimated from annual grain production.

Based on information about the average surpluses of straw, *after* soil conservation practices, from Alberta and Manitoba (Alberta Agriculture 1995; Manitoba Agriculture 1994), it seems reasonable to use a nominal figure of "one tonne of straw per tonne of grain", to estimate the straw supply in the grain-growing regions of the Canadian Prairies. This figure is in the range of the straw-to-grain ratio reported by Staniforth (1979).

In the 1996–97 crop year, the Canadian supply of straw for non-agricultural uses was about 50 million tonnes (Agriculture Canada 1996). The supply of straw (including corn stovers — field residue consisting of stalks, leaves, cobs, husks, and silk) in the U.S. was about four times larger, at 214 million tonnes for the same crop year (Agriculture Canada 1996; Washington State 1995).

It is also interesting to note that most of the surplus straw in the Western states of the U.S. (estimated to be 6 million tons per annum) is currently being burned in the field causing considerable air pollution (in the form of undesirable particulate matter). At the same time, note that the net shortfall of virgin wood fibre for the paper industry in Washington and Oregon has been projected to be about 2.5 million tons in the 1997–98 period (Breuner 1994). Using the surplus straw for pulp fibre would alleviate the paper industry's fibre shortage instantly.

HOW MANY TREES COULD BE SAVED? There are numerous regions of North America in which there is an emerging fibre supply crisis for the paper industry (Breuner 1994; Natural Resources Canada 1996). The acute shortage of economic wood supply is due to, among other things, re-allocation of forest lands for ecological and recreational uses, off-shore market demand for logs and wood chips, improved utilization efficiency of sawmills, and unsustainable exploitation of easily accessible natural forest resources.

It is true that few or no large trees are actually felled today in Canada solely for pulp production. Whole logs are more valuable as lumber than as pulp, and the current industry practice in western North America is to make pulp from residual coniferous wood chips from sawmills. For example, in British Columbia, about 15% of the logs harvested are used (in the form of sawmill chips) for pulp-and-paper production. And logging here is driven economically by both the lumber and wood chip markets. If there were no outlet for wood chips, there would be less economy for harvesting logs for lumber alone. In eastern Canada, pulp wood (smaller diameter trees) is harvested for pulp production, and in the southern U.S., use of pulp wood for pulping is very common. Agricultural cropping residues thus represent an enormous annual source of fibres that could displace wood fibres extracted from the forests.

By considering the following two scenarios, one can see the huge potential of the fibre resident in straw. First, if 50 million tonnes of straw (in Canada) were converted to papermaking pulp at an average yield of 50%, then the potential agri-pulp production would be 25 million tonnes. Coincidentally, this amount equals the 1995 Canadian production (25 million tonnes) of all wood pulp (Natural Resources Canada 1996).

Or second, if 50 million tonnes of straw could be converted to construction-grade lumber, the pressure on wood harvesting could be reduced while still providing exports in the form of straw-based bio-mimic lumber. Based on the following calculations, the equivalent volume of solid wood would be about 136 million m^3.

$$\frac{\text{50 million tonnes of straw}}{\text{368 kg/cubic metre density of white spruce}} = \text{136 million cubic metres}$$

In 1995, there were about 176 million m^3 of industrial wood harvested in Canada (Natural Resources Canada 1996). The total harvest area was almost 1 million hectares.

The number of trees that could be saved on the basis of Canadian straw supply can be calculated as follows:

$$\frac{\dfrac{\text{total weight of straw}}{\text{density of wood}}}{\text{volume of merchantable bole of a tree}} = \text{number of trees}$$

As shown in Table 2, 50 million tonnes of straw, potentially available in Canada, could conceivably save about 500,000 large Douglas fir (*Pseudotsuga menziesii*; coastal British Columbia) trees or about 35 million smaller white spruce (*Picea glauca*; northern Alberta) trees annually.

It may be noted that the typical rotation period for a Douglas fir in the natural temperate rainforest of coastal British Columbia is about 250 years, and for a white spruce with a diameter of 50 cm in the natural boreal forest of Alberta is about 120 years. Agricultural cropping residues are available annually.

CONCLUDING REMARKS Agricultural cropping residues are the only readily available source of fibre for agri-pulp production. Its aggregate quantity of 260 million tonnes in North America could significantly reduce forest-based wood usage for paper manufacture, in real time.

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Table 2 . Estimated tree equivalents of straw

MERCHANTABLE BOLE UNDER BARK

Coniferous Trees	Typical density kg/m^3	Example diameter (cm)	Example length (metre)	Volume per tree (m^3)	Number of tree equivalents (millions)
White spruce	368	50	20	3.9	35.0
Douglas fir	448	150	60	53.0	0.5

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Gaps in freshwater ecosystem research

Understanding freshwaters better would foster conservation of this precious, life-giving resource.

Don E. McAllister, Andrew L. Hamilton, and Brian Harvey

Englehart River,
Kap-Kig-iwan
Provincial Park,
Englehart, Ontario.
Photo: Donald R. Gunn

Water is life. Nature, including humans, cannot survive without it, and the biodiversity found in and associated with freshwater benefits humankind in countless ways. Consider the following facts.

- In 1992 freshwater wild-capture fisheries yielded about 12 million tonnes, with freshwater aquaculture generating about an equal amount of fish, together about one-quarter of the planet's fishery yields.
- Rice, aquarium fishes, rushes for baskets and mats, peat for fuel and gardens, cranberries, and sport fishes are all freshwater resources.
- Aquatic species and ecosystems contribute to the ecological services provided by biodiversity to the planet. Ecological services provided by all forms of biodiversity are valued at several trillion dollars in the U.S. alone.
- Medicines (like aspirin derived from the water-loving willow) and valuable high-tech genetic tools (like the polymerase chain reaction, PCR, technique that was derived from a hotspring bacterium) show some of the promises of future benefits that can be drawn from biodiversity — if we conserve it.

To conserve freshwater biodiversity, we must first understand it in terms of its genetic, taxonomic, and ecosystem characteristics and complexities. In this excerpt we focus on some of the gaps in our scientific knowledge about ecosystem diversity in fresh waters. One such gap is the lack of a global hierarchical classification system for freshwater ecosystems. Another gap concerns ways to effectively apply knowledge of the hydrological cycle. There is also a need to foster research into lesser known freshwater ecosystems, such as groundwater and deep river habitats, and their biota.

NEED FOR CLASSIFICATION The lack of a global hierarchical classification system for freshwater ecosystems impedes conservation, ecologically based management, monitoring, and research. By developing a useful classification acceptable worldwide, freshwater units could be mapped at global, national, and local levels. Biological surveys would provide the grist for this mapping, a geographic information system (GIS) database, and the specimens needed for taxonomic and genetic research. From the new-found knowledge, set within a useful hierarchy, people could quickly see which systems lack protected areas and which are adequately protected. As the world's biodiversity continues to vanish at an alarming rate, making conservation choices based on ecosystems

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Don E. McAllister, Ocean Voice International, Inc., P.O. Box 3332 McCarthy Road, Ottawa, Ontario, Canada K1V 0W0; Tel/Fax: (613) 521-4205; E-mail: <mcall@superaje.com>

Andrew L. Hamilton, 2983 Otterson Drive, Ottawa, Ontario, Canada K1V 7B5; Tel: (613) 350-4332; Fax: (613) 350-4319; E-mail: <ahamilto@ccemtl.org>

Brian Harvey, World Fisheries Trust, 202 – 505 Fisgard Street, Victoria, B.C., Canada V8W 1R3; Tel: (250) 380-7585; Fax: (250) 380-2621; E-mail: <worldfish@coastnet.com; Web site: <http://vvv.com/~worldfish>

may be the most practical way to proceed. By saving an ecosystem, one saves a web of interconnected species, the structural habitat within which they live, plus the individual species themselves — known and unknown — and their genes.

Different attempts at biogeographic and ecological classifications of fresh waters have been made. Banarescu (1990, 1992, 1995) offers a scheme for partitioning the freshwater zoogeographic zones of the world. This provides the top elements for a freshwater ecological hierarchy at the global level.

Lammert et al (1997) provides a classification framework for freshwater communities in North America, based on The Nature Conservancy's Aquatic Community Classification Workshop held 9–11 April 1996. It organizes aquatic ecosystems in four hierarchical abiotic levels — aquatic province, aquatic section, macrohabitat type, and habitat type, and in two hierarchical levels of biological organizations — alliance (broad scale of community organization) and association (fine scale of biological classification). This approach has the advantage of clustering similar habitat types in a hierarchical classification at the continental level, enabling one to appreciate which habitat sites are distinctive. This classification, however, has not been extended to cover all the continents.

An alternative approach to classification has been taken by the World Wildlife Fund (WWF)-U.S. WWF has produced freshwater ecoregion maps for Latin America and the Caribbean (117 ecoregions), and North America (76 ecoregions). The ecoregions consist of drainage basins, or portions of basins, characterized by assemblages of species. The ecoregions are not arranged in a hierarchy other than "continent of occurrence" or "major habitat types." For example, for North America we find the following habitat types: arctic rivers and lakes; large temperate lakes; temperate coastal rivers and lakes; large temperate rivers; temperate headwaters and lakes; endorheic (closed-basin) rivers, lakes, and springs; xeric region (hardly any moisture) rivers, lakes, and springs. The WWF ecosystem approach is basin-oriented, which is useful for management purposes because a number of the stresses on freshwater are land-based. But the system is not broken down into marshes, oxbows, springs, and so on. Also, the WWF system has only been applied to North and South America.

The conservation status of the ecoregions can be evaluated by degree of land cover alteration, water quality degradation, alteration of hydrographic integrity, degree of habitat fragmentation and "other" losses of original habitat and native species, as well as effects of introduced species and direct species exploitation. These factors can be summarized by weighting conservation status indicators for each major habitat type and calculating a "snapshot total." The likelihood of future threats can also be included in evaluating the ecoregion's conservation status, and there is the opportunity to give rankings such as critical, endangered, vulnerable, relatively stable, or relatively intact. This approach enables one to focus on conserving ecological groupings of many species (described and undescribed), rather than attempting to save species one at a time, which is less effective.

Measurements of ecological integrity are rare, in part because of the lack of suitable indicators (SOE 1996). A study of 45 major rivers in Nova Scotia showed that 19 had impaired ecological integrity. Efforts being made to combat acid rain in Canada, and the Department of Fisheries and Oceans policy of "no net loss" of fisheries habitat are important steps forward in protecting and restorating freshwater ecosystems. On the other hand, Canada's significant cuts in freshwater research program budgets jeopardize unique work and expertise, some internationally acclaimed. Concern has been expressed that Canada and other countries are losing the capacity to address national, bilateral, and international water issues (Bruce and Mitchill 1995; UN 1997).

This is an excerpt from "Global freshwater biodiversity: Striving for the integrity of freshwater ecosystems," *Sea Wind* 11(3), produced for the Strategy for International Fisheries Research, International Development Research Centre (SIFR/IDRC), August 1997.

Inglis Falls, Owen Sound, Ontario. Photo: Donald R. Gunn

HYDROLOGICAL CYCLE The hydrological cycle is understood by climatologists and other specialists. But there is a gap in popular appreciation of this knowledge for conservation and management, and there are few actual drainage basin applications. Yet one cannot conserve or manage freshwater ecoystems without understanding the effects of the cycle. Briefly the cycle comprises the following elements:

- Rain (or snow) condenses and falls from the clouds on natural vegetation. On the ground some is absorbed by leaf litter, humus, and plant roots — where the soil has not been bared by logging or agriculture — while some "excess" runs off.
- The water, taken in by plants, is transpired into the air, facilitated by the immense area of plant leaves. Here the moisture forms clouds and eventually rain.
- Some of the excess runs directly into streams, rivers, or the sea. The rest runs down into the soil, facilitated by the porosity that has been created by worms and other organisms in healthy soil. It drains down through the soil to the water table where it either forms more or less stable underground "seas" or "ponds", or drains towards rivers, lakes, and marshes.

The lack of a global freshwater classification system hampers the management of biodiversity.

When vegetation is removed, seasonally or more or less permanently, there is more direct runoff to river basins and to the oceans — even though there is still evaporation from the soil surface — and the input into the rain-transpiration cycle is lessened. Leaf litter is often lost and humus levels are lowered. Droughts, downwind (referring to the prevailing winds) from clear-cut areas, have been assigned to forest clearing activities, but vegetational-hydrological studies have been carried out in few drainage basins.

NEED FOR NEW KNOWLEDGE There is a great variety of freshwater ecosystems. These include the still waters of lakes, ponds, and even temporary pools. The world's one million lakes, those bodies of water that are larger than a hectare, vary in size and characteristic. There are deep, cold lakes (nutrient-poor or oligotrophic) with little in the way of nutrients needed for the primary producers in the food chain — green plants. There are shallower, warm lakes (mesotrophic) that have intermediate levels of mineral nutrients and consequently, more plants. There are lakes with waters rich in mineral nutrients that host an abundance of primary producers or plants (eutrophic). Then there are the deep tropical lakes with no oxygen at all in their depths — no oxygen, no plants at all. After lakes come ponds and pools. The world's 10 million ponds (smaller than a hectare), and ephemeral pools (Belk 1997), most much smaller still, provide an immense range of habitats for a variety of micro-organisms, plants, invertebrates, and vertebrates. Stream and river habitats are equally diverse. There are torrents, pools, riffles, flood plains, oxbows, and riverine lakes; rock, boulder, gravel, sand and mud bottoms; clear, cloudy, turbid, and "black" waters: cave waters; first, second, third order streams; cool, warm, and hot waters and those with planktonic or macro-plant life — floating, emergent, submergent, and encrusting (periphyton) vegetation, or lacking vegetation. Research is needed everywhere, but there are a few areas that stand out.

The unseen groundwater realm is being degraded before its biota have even been explored.

Connections between aquatic, semi-aquatic and terrestrial zones The ecology of streams and rivers is substantially covered in Hynes (1970) while conservation aspects are discussed by Allan and Flecker (1993).

The typical progressive change in rivers from headwaters in highlands, through middle reaches and lowlands to mouths is well studied, though the pattern is not fixed. But there is a need for research on a second axis, running perpendicular to the first across the floodplain and encompassing the lateral extent of aquatic, semi-aquatic, and terrestrial habitats (Dudgeon et al 1994). Groundwater movement, farmland runoff, and leaf-fall from trees are a few of the elements involved in later biotic and abiotic transport.

Groundwater Another gap lies in our understanding of groundwater, where a great proportion of freshwater is located — 66 times more than in lakes, streams, *soil moisture,* and atmosphere (Watson et al 1996). (Precipitation enters the surface of the soil to form soil moisture in unsaturated soil, or drains down to become *groundwater* in saturated soil or rock where all pore spaces are filled with water.) How much precipitation flows into the groundwater and thence into rivers and lakes? What are/were the natural chemical and physical characteristics of this water? What microbiota live in the groundwater environment? What ecological roles do the microbiota play? Do any have potential in biotechnology?

Some of these underground water bodies are immense and thousands of years old and their species may be ancient. Many of these water bodies are being rapidly depleted to supply water for irrigation, industry, and household use. The level of the Ogalla Aquifer that lies under eight of the states in the U.S. Great Plains is dropping by up to a metre a year. Bangkok's water table has plunged 25 metres since the late 1950s and saltwater has penetrated its wells (Lean et al 1990). Many groundwaters are being polluted by toxic chemicals and nutrients, and some aquifers in coastal areas by saltwater intrusion due to excessive withdrawals. The groundwater realm, a series of tiny to vast underground lakes, is being diminished and degraded before its unique biota are explored.

An inkling of the diversity and complexity of the deeper groundwater microbiota was first given by Fliermans and Balkwill (1989). Their drilling of deep aquifers in South Carolina revealed large numbers of peculiar bacteria down to at least 520 metres below the surface. The species changed from one strata or layer to the next, but there was no obvious overall decrease in viable bacterial numbers with increasing depth. More than 3,000 forms, all new to science, were found in the early probes — only about 5,000 species of bacteria have been scientifically described to date. Now the known depth of underground bacteria has been pushed to 2.75 km in northeastern Virginia (Kerr 1997). Some of these bacteria, living at temperatures of up to 75°C, extract energy from ancient organic matter in nearby rock.

One can imagine that these may have important ecological functions. One can imagine that some might have potential value in biotechnology. One can imagine that the microbiota in aquifers and groundwaters in the shrinking Ogalla Aquifer, and beneath the Sahara Desert, Australia, and Japan might be significantly different. But we have no way of knowing without additional research.

The Lion's Head, Bruce Peninsula, Ontario
Photo: Donald R. Gunn

Annual flooding of rivers nurtures biodiversity, but we need to know more — before development decisions about rivers are made.

There is probably a greater diversity of life in the deep aquifers and groundwaters underneath our feet than on Mars. It could be retrieved at a fraction of the cost of Mars probes without affecting Mars exploration. Most of our microbiologists are currently studying the diseases of humans, domestic animals, and crops. Why not put more resources into study of "wild" bacteria? We do not even know how deep microorganisms live in the Earth.

The existence of deep groundwater bacterial floras, differing from strata to strata, and the contamination of groundwaters, poses the question of their conservation. Is groundwater contamination affecting unique groundwater ecosystems?

Surface waters The importance of microbial ecology in surface waters is being increasingly appreciated and studied as demonstrated in the International Workshop on Aquatic Microbial Ecology held in 1995 at the University of Konstanz, Germany (Lucas et al 1997). Microorganisms play important roles in the major cycles of carbon, nitrogen, sulphur, iron, and manganese, as well as with their own role in food webs. Microorganisms also play a vital role at the water-sediment interface in organic matter metabolism, transport of nutrients and other solutes across the interface, with an oxic surface skin underlain by a deeper anoxic layer. We need to know more.

Fast, deep waters Also unexplored are the faster and deeper waters of very large rivers, in part due to lack and difficulty of sampling, in part due to lack of appropriate gear. Recent deepwater work at 10–50 m in the Amazon has revealed upwards of 240 new species, plus new genera (Anonymous 1997). These are dominated by electric fishes and catfishes, many with eyes reduced or lacking — little light reaches below 10 m in the murky water. The opportunity to study deepwater biota in large Asian rivers in undisturbed states is rapidly fading, if not gone (Hynes *in* Dudgeon et al 1994), and study of what is left should be given priority.

Ephemeral pools Although easily accessible, ephemeral pools are poorly studied. In the spring pools of one region of California, 43% of the known crustaceans, some 30 species, were undescribed by science. Such pools contain several endangered species of fairy and tadpole shrimps in the U.S. (Belk 1997). Vernal pool habitat can also contain rare plants like Parish's meadowfoam, *Limnanthes gracilis* var. *parishii*, known from Shrine Pool, California (Winter and Higgins 1997).

Seasonally flooded areas The appreciation of seasonally flooded areas such as forested wetlands as spawning and nursery habitats increased following publication of Goulding's (1980) book, *The Fishes and the Forest.* Seasonal flooding contributes to the sustainable benefits that can be drawn from intact river bottom forests. Cambodia's Tonle Sap, or "Great Lake," expands five-fold, thanks to floodwaters from the monsoon-fed Mekong, to 13,000 km^2 (Ahmed and Tana 1996). With its annual fish catch of 100,000 tons, it is the main protein source for Cambodia's 9.5 million people. It is home to a spectacular abundance of birds, cranes, and fishes that have earned it a nomination for UNESCO World Heritage status. Clearly, annual flooding fosters productivity and biodiversity, and changes in the natural annual water rhythm will threaten that biodiversity. *Before* development decisions are made about any annually flooded area, more research needs to be done into this ecosystem. Yet hydroelectric development of huge and complex drainage basins is being promoted.

Others Riparian zones and the ecology of large river systems are two more main areas that are being researched and need continuing work. There are also a host of other smaller aquatic ecosystems that need to be considered. Smaller bodies of waters, such as springs, sometimes contain endemic species that are especially subject to human-induced threats in arid areas. Cave water systems sometimes contain blind unpigmented species uniquely adapted to those systems. Waters usually or seasonally with low oxygen levels may be inhabited by species capable of breathing air. Tiny pools of water — complete ecoystems unto themselves — are found in epiphytic bromeliads in tropical rainforests and are used for breeding by insects and amphibians. Artificial freshwater ecosystems include fish ponds and human-made reservoirs, paddy fields, and canals. Discarded coconut shells, cans, bottles, and automobile tires may hold enough water for mosquitoes to breed in; the latter have fostered the spread of the tiger mosquito.

IN CONCLUSION There are many, many gaps in our knowledge of freshwater, but in particular, investment in studying freshwater ecosystem classification, the hydrological cycle, and the diversity and ecological roles of deep aquifer and groundwater bacterial floras, as well as their potential in industry would *certainly* be worthwhile.

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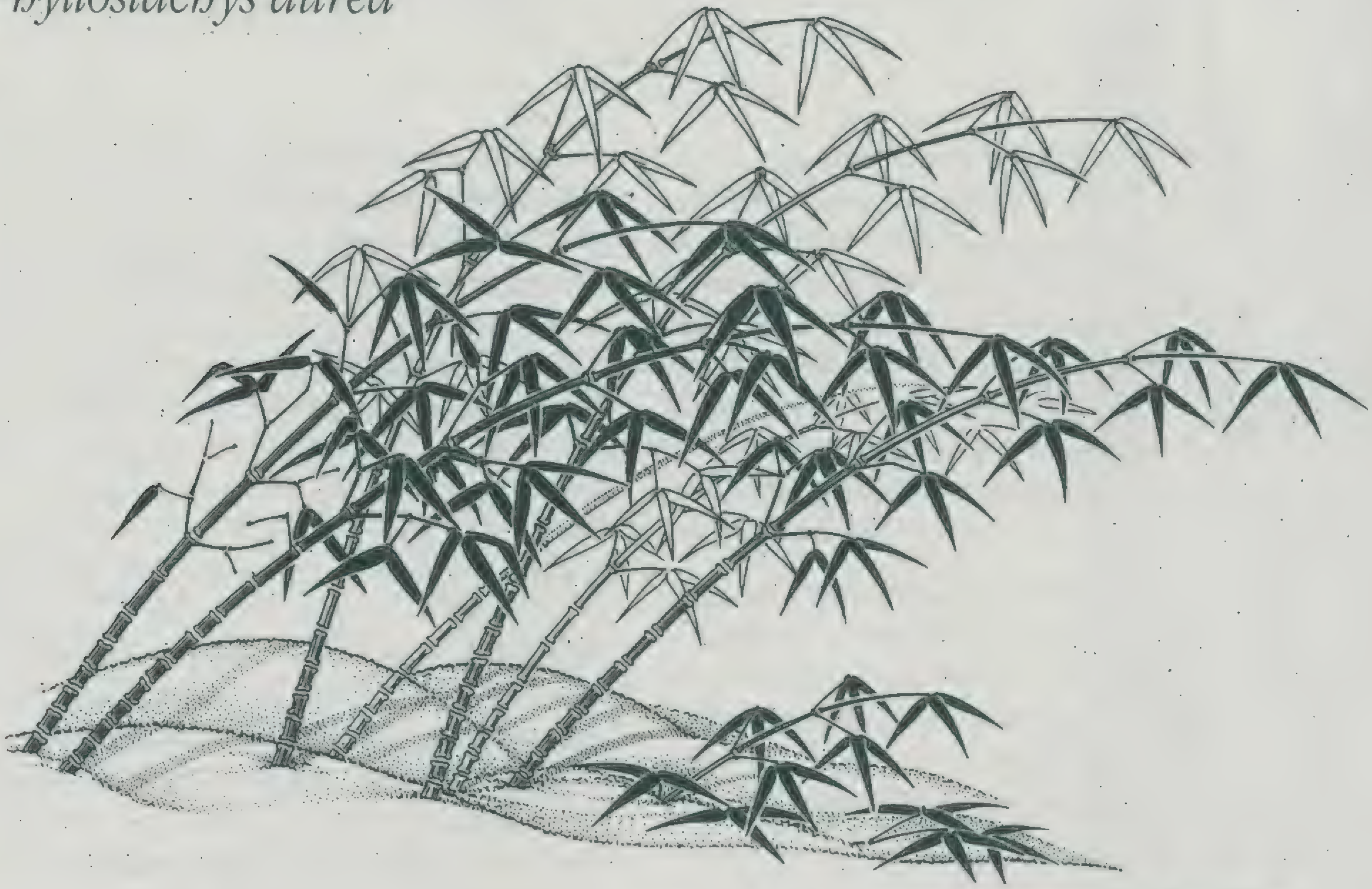
Bamboo

Phyllostachys aurea



Illus.: Roelof Idema

Phyllostachys aurea, one of 1,100 to 1,500 species of bamboo, is found as far north as Washington, D.C. in eastern North America and British Columbia in the west. Like other bamboos, it is distinguished by a woody culm or stem, complex branching, a vigorous rhizome system, and infrequent flowering. Bamboo, in essence giant woody grasses, can be found in wide areas of Africa, Asia, Latin America, and the Caribbean. Despite being so widespread, the taxonomy and classification of bamboo remains poorly understood, so the exact number of genera (believed to be between 60 and 90) and species is not known. Because bamboo rarely flowers, flowers are difficult to collect. New culm leaves and branch complements — critical for species identification — also need to be sampled to be helpful taxonomically.

Bamboo has been an important commodity for centuries, and today global trade in bamboo is estimated at $4.5 billion, while domestic trade is valued at $2.7 billion. No wonder, since a single bamboo clump can produce up to 15 kilometres of naturally pre-finished, ready-to-use culms in its lifetime! This "plant with a thousand faces" can be found in products ranging from musical instruments to bridges, furniture to paper, fishing nets to irrigation pipes.

Equally important is the role it can and does play in soil preservation. Due to its impressive rhizome system it hinders soil erosion, and is useful on road embankments. It can also provide fast vegetative cover in deforested areas. Bamboo can also be harvested without disturbing the soil because the culms can be cut directly from the rhizomes and it provides its own leafy mulch.

[Adapted from an IDRC backgrounder on bamboo found at <http://www.idrc.ca/media/inbar_bamboo_e.html>]

Managing the Canadian forest for biodiversity

How are forest managers responding to the call to conserve biodiversity? A 1996 survey gives some answers.

Katja Power

Pileated woodpecker
Illus.: Roelof Idema

Over the last decade there has been a shift in forest management in Canada from a once narrow focus on the management of commercial tree species for wood products to an integrated style of management focused on all forest resources. Based on the development of the Canadian Biodiversity Strategy in 1994, the Canadian Forest Service (CFS) introduced a three-year national forest strategy for implementing the Biodiversity Strategy in 1997. This strategy includes, among others things, the development of guidelines for forest management to maintain biodiversity, and the incorporation of specific measures to maintain biodiversity in forest management plans (Canadian Forest Service 1997). Additionally, some provinces, such as Quebec, have already developed their own biodiversity strategies or action plans.

Biodiversity is described as the richness and variety of life on Earth, whether it is in the air, on the land, or in the water (Boyle 1992). The greater this indigenous or native variety is, the greater the ability of the system to adapt to change due to natural causes or as a result of human activity. Biological diversity occurs at the genetic, species, and ecosystem levels (Namkoong 1991), and landscape diversity, a further level of biological diversity, has been defined as "the mosaic of interacting ecosystems" (Canadian Forest Service 1997). Preserving landscape diversity is essential for maintaining ecological integrity and conserving gene, species, and ecosystem diversity. Sustaining biodiversity at all levels is the concern of the Canadian Biodiversity Strategy. The Canadian Biodiversity Strategy also aims, like the International Convention on Biological Diversity, to preserve the ecological services that sustain the planet from local to planetary levels. Mosquin et al (1995) classify and describe 21 of these services or functions. Several, like carbon banking, sustaining the hydrological cycle, and providing habitat, have particular relevance to forests.

Forest management for biodiversity is often difficult because there are no concrete objectives — we only know that diversity is needed for the viability of the biota (Namkoong 1991). While research is being carried out to answer questions such as "what level of biodiversity is good" and "how do we measure it" both government and industry have instituted practices and procedures directed towards sustaining biodiversity at all levels.

All provinces and many large forest companies have guidelines that constrain activities in riparian areas, around water bodies, in areas where there are endangered species, raptor nests, ungulate wintering, or where soil may be lost through erosion. Industry guidelines are implemented in their forest

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Katja Power, Forest Inventory & Analysis, Canadian Forest Service, Pacific Forestry Centre, 506 West Burnside Road, Victoria, BC V8Z 1M5; Tel: (250) 363-0615; Fax: (250) 363-0797; E-mail: <kpower@pfc.forestry.ca>

management policies, while provincial guidelines on crown lands are usually enforced indirectly. The constraints on harvesting are important because they help protect individual habitats, streams and lakes, and certain species. However, the constraints do not necessarily guarantee the *continuity* of functioning ecosystems.

The guidelines currently in use have been made clear, easily understood, and workable in the forest, with an emphasis on stands and a 20-year planning horizon. For example, guidelines include restrictions on clearcut size, specify the minimum area to be left along stream banks, and detail the number of snags to leave for animal use. It is becoming clearer and clearer, however, that guidelines must address landscapes, with a 100 year or more planning horizon (Thompson and Welsh 1993). The protection of the integrity of soil ecosystems is also important.

Now that they have been in place for several years, and have had time to filter down to forest managers, it is time to take stock of how the guidelines have been followed in planning, inventory, and operations. To this end, in 1996, I interviewed people in 14 different companies from Ontario to British Columbia, as well as in two model forests, and three provincial departments of natural resources (see Acknowledgments). I wanted to find out what tools and data they have at their disposal, what they need, and what is being developed to deliver the broad objectives and guidelines in front of them. The survey was concluded when the number of repetitive replies outstripped any new information gained, and the findings from the survey are presented in Table 1. The 1996 results will give a baseline of information against which to compare changes arising from the new 1997 CFS guidelines to improve forest management practices for biodiversity.

RESULTS OF 1996 SURVEY

1. Does your organization have any policy frameworks for forest management with respect to biodiversity, stating what is needed and how much?

The responses fell into three broad categories:

- Policies are contained in the provincial legislation, and referenced in a corporate position paper, or a stated policy framework is the result of the provincial legislation.
- Policy is set out in the forest management plan, forest management policy, or standard operating procedure, or there is an explicit statement addressing biodiversity — it is part of the corporate goal.
- Policies are in draft form or are being developed as part of ongoing research.

2. Has forest planning in your organization changed due to the current emphasis on biodiversity?

Some of the modified forest-management practices now in use are:

- leaving buffer zones around water courses, including flood plains, terraces, and steep slopes, and managing these to provide continuous cover for wildlife and to link forest stands;
- leaving deer wintering yards;
- carrying out modified harvesting (i.e. shelterwood, understory retention/protection, reserving protected areas from harvest, and managing the landscape so that harvesting can be carried out while still conserving biodiversity and other values at the landscape scale);
- ensuring a "natural" mixture of age classes (age class structure of undisturbed forests), including some mature and overmature classes;

> Moving to ecosystem-based management requires forest landscape and biodiversity modelling tools.

Table 1.

- retaining snags, live trees, and wildlife patches in harvested areas;
- emulating fire effects in a forest on a landscape basis by creating a similar distribution of age classes and mimicking edge effects using careful logging and smaller patch sizes;
- retaining older pine forests with lichen for woodland caribou habitat;
- replanting after harvesting with stock grown from locally collected seed;
- ensuring reduction of forest fragmentation and retaining coarse woody debris on the forest floor; and
- maintaining a certain percentage of every ecosystem in an ecoregion at any one time — the target is a "natural" forest, free from human influence (including protection from pests and fires).

3. Are there any plans, actions, or initiatives in place to monitor biodiversity?

Ongoing monitoring efforts are mostly restricted to species sampling. Examples are:

- surveying tree species on all cutovers five years after harvesting (forest renewal monitoring);
- sampling specialist and indicator species, including birds (e.g., trumpeter swan in Alberta), small mammals, plants, lichen, amphibians, large mammals (e.g., woodland caribou), and bull trout. Some species are being sampled on harvested and burned areas. At the same time these surveys are taking place, research attempts to discover which species are the best indicator species;
- enhancing forest resource inventory, which includes information on stand structure, soils, snags, and understory vegetation; silvicultural surveys; and land base cover surveys;
- Environmental Impact Assessments, 20-year forest management plans, and integrated stand management plans (provincial guidelines);
- baselines for historic ecosystem variability;
- growth and yield plots, established for detailed forest inventory on an ecological basis; and
- permanent sample plots on streams for long-term monitoring of fish species composition and abundance.

4. Are you aware of or using any management tools devised by research or management institutes to improve forest management with respect to biodiversity?

There are many types of models in use and under development, including:

- habitat suitability/supply indices;
- forest succession growth and yield models for forecasting;
- models to evaluate the influence of proposed harvest level on long term (100 years) timber supply as well as on forest ecosystems and wildlife habitat, to answer questions about the sustainability of the timber supply, the structure of the age class distribution, the forest ecosystem types, and wildlife habitat at the ecoregion level;
- models to predict and manage vegetation and habitats in mixed-wood forests;
- models for baseline natural disturbance regimes;
- models for quantifying the number of trees per hectare, both live and snags, and coarse woody debris needed by birds and small fur bearers;
- species dispersion models;
- research on fires (sizes, shapes, what is left behind), insects, and diseases within an ecological as well as administrative framework;
- spatial patterns of natural disturbances; and
- spatially explicit harvest scheduling tools to develop feasible harvest schedules, used with a spatial habitat supply model, habitat attribute trajectories, and species dispersion models to assess compliance with biodiversity regulations and the cost of regulation and achievement of habitat supply objectives.

DISCUSSION OF RESULTS A policy framework that outlines the goals and objectives for forest biodiversity (what is needed and how much) is paramount to successfully managing the resource. The responses to the first question about the existence of such frameworks illustrate that policies for forest management with respect to biodiversity have become firmly entrenched during the last decade.

In addition, the answers to the second question, whether or not forest planning has been changed by a biodiversity focus, indicated that respondents were either already heavily involved in planning for biodiversity, or most definitely aware of the importance of this management strategy. Several have committed to incorporating such a strategy in their next forest management plan.

Stated biodiversity objectives range from very broad objectives in forest management plans (for example, that the total area of softwood, softwood/hardwood, hardwood/softwood, and hardwood forest types not fluctuate by more than 10% within 80 years in New Brunswick) to management for sustainable biodiversity as a stated goal of forest planning (for example, including preharvest assessments of biodiversity as a part of integrated stand management plans). Provincial forest management agencies in British Columbia (Fenger 1996), Ontario, and Quebec have developed definite guidelines and specifications for forest management with respect to sustainable biodiversity. In these provinces, companies tend to let legislated codes of practice drive their forest management. In provinces where such regulations are lacking, the forest industry appears to be more proactive in pursuit of biodiversity objectives.

All surveyed organizations had management to maintain biodiversity (as opposed to fibre maximization) as either a corporate or a management goal. As an example, Alberta Pacific Forest Industries Inc. states in its draft "Detailed Forest Management Plan" of 1 December 1995: "...the Company will...implement boreal forest ecosystem management by conducting planning, harvesting and post-harvest activities in a manner that will maintain biodiversity; retaining the full range of forest age classes (including older forest stands), existing landscape patterns and structure for wildlife habitat in harvested areas (live trees and patches, snags, woody debris)."

Three out of twelve companies have endorsed the Canadian Standards Association (CSA) sustainable forest management standards for certification. Measures needed to attain certification have been undertaken by these companies, and in one case, an internal audit will be used to publicize what needs to be done to achieve that goal. Once measures are in place, forests will be audited to ensure compliance.

With regard to the third question, about monitoring forest management for biodiversity, most respondents realized that monitoring is a prerequisite for success. However, current monitoring programs and the ability to carry out monitoring varied among the respondents. The lack of action can be traced to uncertainty about what should be measured and how. The organizations I interviewed are still researching this, with the aid of scientific advisory boards.

As the answers to the fourth question, about successful forest management tools, indicate, many of the practices to sustain biodiversity are still stand-oriented, even though the industry says it recognizes that management must be done at a landscape level. Companies are finding it difficult to move in a concrete way from stand-based constraints to landscape- or ecosystem-based management. To assist such a move, forest landscape and biodiversity modelling tools will be required (Thompson and Welsh 1993). The models have either been developed by industry alone, in cooperation with other agencies (including universities, research councils, the Canadian Forest Service, provincial governments, and Wildlife Habitat Canada), or by provincial agencies for the use of the forest industry in their provinces.

CONCLUSIONS

So, what is the current state of forest management for biodiversity in Canada? The responses to the survey indicate that Canadian forest managers are aware of the need to change the focus of forest management from maximizing fibre to sustaining biodiversity. They have made the emphasis on biodiversity a part of corporate policy and ensconced it in provincial regulations. Biodiversity is now a goal of forest management plans, along with sustainable fibre production. Monitoring biodiversity at all levels and tracking performance have become the overriding challenges. Forest managers are using and creating landscape-level models to help them more effectively manage biodiversity, and to monitor how they are doing. It will be more than a few years until the results of their efforts are known. For now, it is encouraging to know that efforts are ongoing on many frontiers. It is crucial that we learn from these experiences what works and what does not.

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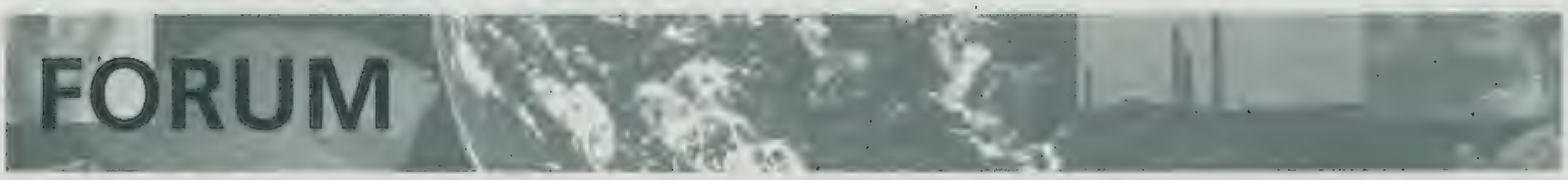

FORUM

THE MAI AND BIODIVERSIY Editor's Note: In April 1998 the Multilateral Agreement on Investment (MAI) will be signed by the 29 member countries of the Organisation for Economic Co-operation and Development (OECD). There have been strong views expressed around the world both in support of the MAI and against it. A few opinions are printed below. For more information, visit the Forum pages on our web site <http://www.nature.ca/english/gbfor.htm> for cyber links and other viewpoints. What's your opinion?

Another sort of multilateral agreement needed

Adapted from a statement made by Mike Nickerson, of The Sustainability Project — Inviting Debate. For more information visit his web site at <http://www.cyberus.ca/choose.sustain>

It may be time for a global constitution. It would be a historic step, a landmark in the maturation of our species. It is not a step that should be taken lightly or in haste. It took several years of open negotiations to establish the Biodiversity Convention. The MAI, on the other hand, is being pushed through at an alarming pace. It focuses only on the interests of international investors and neglects other matters of importance to civilization and human well-being....

There is another agenda. Over the last 50 years nations have met together to develop covenants, treaties, and conventions in the interest of all humankind. To date, through slow, open, and accountable processes, the nations of the world have made the following commitments:

- to promote and fully guarantee respect for human rights and social justice;
- to ensure the preservation and protection of the environment;
- to create a global structure that respects the rule of law;
- to achieve a state of peace, justice and security; and
- to enable socially equitable and environmentally sound development.

These agreements provide a solid foundation from which to pursue unifying rules of fair conduct. The MAI would effectively nullify the hard work that has gone into them.

If there is to be a Multilateral Agreement it needs to include not just economic efficiency (narrowly defined as maximizing profits), it needs to include democratic rights, recognition that everyone needs to participate in the economy with a degree of equitability, a competition policy, a corruption policy, indigenous rights, a global tax authority, the regulation of currency speculation and safeguards for labour, environment and resource supplies....

If the Multilateral Agreement being pursued were founded on these values, disadvantaged and average people would benefit. Future generations would benefit. The loss would be to short-term profits, but the losers, although remaining fabulously wealthy, could also share in passing onto their children a world of hope.

Why should we have agreements allowing investors to roam the planet looking for the lowest taxes and the lowest standards for environment and labour? These are not poor institutions in need of a break. Many have more wealth than most nations. The MAI could as easily require international companies to take with them the highest labour and environmental standards existing — to practice responsible global citizenship rather than sinking into the role of pirates exploiting weakness wherever they find it.

If the MAI required investors to abide by the highest, most responsible standards when they seek investment opportunities in other countries, the whole world could aspire to high standards and truly benefit from investment. The "playing field" would be really "levelled," and civilization could remain standing upright.

What will happen to environmental standards?

Sent by the OECD as part of a public information document.

MAI negotiators have recognized the importance of environmental concerns and will ensure that governments keep their freedom to implement policies to protect the environment, provided those policies are not more stringent for foreign investors than for domestic ones.

A range of specific proposals is being considered. For example, the MAI preamble will likely recognize the importance of sustainable development. MAI negotiators are examining provisions modelled on the North American Free Trade Agreement (NAFTA) to make explicit the right of governments to maintain environmental requirements consistent with national treatment and most-favoured nation treatment, and to provide that MAI parties should not lower their environmental standards to attract foreign investment.

Most negotiators support association of the OECD Guidelines for Multinational Enterprises, with its chapter on environmental matters, with the MAI. Other environmental proposals may be considered.

Introduction to a joint NGO statement on the MAI

Released 27 October 1997.

As a coalition of development, environment, and consumer groups from around the world, with representation in over 70 countries, we consider the draft Multilateral Agreement on Investment to be a damaging agreement that should not proceed in its current form, if at all. There is an obvious need for multilateral regulation of investments in view of the scale of social and environmental disruption created by the increasing mobility of capital. However, the intention of the MAI is not to regulate investments but to regulate governments. As such, the MAI is unacceptable.

MAI negotiations began in the OECD in the spring of 1995, more than two years ago, and the OECD claims they are substantially complete. Such negotiations have been conducted without the benefit of participation from non-OECD countries and civil society, including non-governmental organizations representing the interests of workers, consumers, farmers, or organizations concerned with the environment, development, and human rights.

As a result, the draft MAI is completely unbalanced. It elevates the rights of investors far above those of governments, local communities, citizens, workers, and the environment. The MAI will severely undermine even the meagre progress made towards sustainable development since the Rio Earth Summit in 1992.

The MAI is not only flawed in the eyes of NGOs, but conflicts with international commitments already made by OECD member countries:

- The MAI fails to incorporate any of the several relevant international agreements such as the Rio Declaration, Agenda 21, the UN Guidelines for Consumer Protection (1985), the United Nations Conference on Trade and Development (UNCTAD) Set of Multilaterally Agreed Principles for the Control of Restrictive Business Practices (1981), and the HABITAT Global Plan of Action.
- The MAI fails to comply with OECD commitments to integrate economic, environmental, and social policies (OECD Ministerial Communique May 1997).
- The MAI removes the responsibilities of transnational enterprises that were previously agreed to by the OECD under the OECD Guidelines for Multilateral Enterprises 1976 (OECD Ministerial Communique May 1997).
- The exclusion of developing countries and countries in transition from the negotiations is inconsistent with OECD policy on development partnerships ("Shaping the 21st Century: The Contribution of Development Cooperation," OECD 1997).

Problems with the MAI stem both from the broad restrictions it places on national democratic action, and from its failure to include sufficient new systems of international regulation and accountability.

Send us your views. The Canadian Museum of Nature is pleased to provide an open forum for diverse viewpoints even though they may not represent the views of the Museum itself. Comments on articles in *Global biodiversity* and any biodiversity issues are welcomed. Anonymous contributions will not be published. Please note: by sending in your views, you give the Canadian Museum of Nature permission to publish your views on our web site <http://www.nature.ca/english/gbfor.htm> and/or in *Global biodiversity* magazine. We reserve the right to edit or condense comments as required. *E-mail: <cripley@mus-nature.ca>*. Fax: 613-566-4763. Mail: *Global biodiversity* Forum, Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario Canada K1P 6P4.

As the MAI stands, it does not deserve to gain democratic approval in any country. All the groups signing this statement will campaign against its adoption unless changes, including those cited below, are incorporated into the body of the MAI.

NGOs supporting this statement include: ANPED; Association for Sustainability & Equity in the Americas; Canadian Environmental Law Association; Center for International Environmental Law (CIEL); Central and Eastern European Bankwatch Network; CEECAP-Poland; Consumer Unity & Trust Society (CUTS); Council of Canadians; Ecoropa-France; Equipo Pueblo; Friends of the Earth England, Wales and Northern Ireland; Friends of the Earth International (FoEI); Friends of the Earth United States; Focus on the Global South; Forum Environment and Development; Global Help Project; NABU; Netherlands Committee of the IUCN; Pacific Environment & Resources Center — Pacific Rim; People's Forum 2001, Japan; Public Citizen; SAWTEE, Kathmandu; Sierra Club of Canada; Swiss Coalition of Development Organisations; Tools for Transition; Women's Environment & Development Organisation (WEDO); World Development Movement; World Economy, Ecology and Development Association (WEED); World Information Transfer; World Wide Fund for Nature International (WWF-I).

Resist the hijacking of the biosafety debate!

Bob Phelps, Director, Australian GeneEthics Network, c/o ACF, 340 Gore St., Fitzroy, 3065 Australia. Tel.: (03) 9416-2222; fax: (93) 9416-0767; e-mail: <acfgenet@peg.apc.org>.

[Editor's Note: These comments are based on the Australian GeneEthics Network's response to the Australian Government's draft for the October 1997 meeting of the Ad Hoc Working Group on Biosafety (BSWG). For background information on this meeting, see the BSWG report, *Global biodiversity* 7(3): 31-33.]

BSWG delegates, we urge you all to resist the efforts of Western Governments (including Australia) to hijack the biosafety debate and reduce the precautionary rules for the international transfer of living modified organisms (LMOs).

First, the scientific basis for genetic engineering is under question. Genetic science should not be the sole basis for risk assessments. The scientific underpinnings of genetic engineering, the Watson-Crick paradigm of the gene, is under fundamental questioning by scientists such as Richard C. Strohman, emeritus professor in molecular and cell biology at the University of California at Berkeley, in the article "The coming Kuhnian revolution in biology," *Nature Biotechnology,* Vol. 15, March 1997. Without a sound basis in good science, the technology is set to have myriad unforeseen impacts.

Second, most of us will be importers of LMOs. For the foreseeable future, all countries except the U.S. will probably be net importers of LMOs. It should be in the national interest of those countries that are also centres of megadiversity (like Australia) to adopt a Protocol that treats the importers of LMOs fairly. The drafts to date give too much power to exporters and too little to importers. For example, exporters must carry the burden of proof that their proposals will not harm biodiversity, rather than the importing Competent Authorities having to demonstrate unacceptable risk. Parties are rightly most interested and able to protect and nurture the biodiversity within their own boundaries. They should be empowered to do so, by at least having a level playing field with exporters.

Third, essential elements and modalities of the Protocol should include:

- **Precautionary principle** Adherence to this principle means that where reasonable doubts over biosafety exist, the onus must be on the proponents to dispel it, not on the proposed importers to justify their rejection of an application. No approval of transfer, handling or use of LMOs should be given unless there is very full evidence, to a high degree of certainty, of its safety and lack of risk to the environment and human health.
- **Ethical, socio-economic and human health risks** The motivation for exporting LMOs will in the main be industrial and commercial. It is therefore illogical and unfair that scientific assessment (confined exclusively to the microbiological and environmental sciences) should be the only basis for assessing risks and hazards. This approach unreasonably and irrationally ignores the rest of scientific and "non-scientific" knowledge and information. They are also essential components of a well-founded assessment of all impacts. For example, Australia's exclusion of Bovine Growth Hormone, for economic and social reasons related to export trade, was a well-founded and correct decision.

- **Public participation** The Protocol should provide guarantees of the widest possible public participation, as agreed to by the Parties in Agenda 21 (16.30). It should include measures to encourage such participation and also to require full public access to information used for making LMO-related decisions. Information on proposed LMO releases should be provided to everyone well in advance of any decision.
- **Liability** The Biodiversity Convention itself seeks to make Parties liable for protecting biodiversity, as well as having sovereignty over the biosphere, and reaping its benefits. If exporters are unprepared to accept any liability, there can be no requirement for importers to accept LMOs or give reasons for rejecting them. Liability should be incurred upon any proof of damage or loss, including to ecosystems. No marketplace can be free unless parties have equitable access to compensation for any damage. This is in exchange for the benefits derived. Excluding any liability or compensation provisions, may greatly distort trade in LMOs.
- **Emergencies** Precautionary measures and plans should be proposed, adopted and implemented prior to the introduction of LMOs.
- **Financial** Importing Parties should be able to recoup their administration costs from exporters.
- **Open information flow** Minimum, not maximum, standards should be set for the information to be provided by exporters. There should be no limits on importers' rights of access to information. If a proponent company, exporting party, or clearing house knows anything important of relevance to an assessment, they must disclose it regardless of suggested Commercial in Confidence provisions. The cases of tobacco, drug, chemical and other companies not disclosing negative evidence of the impacts of their products are now legion. The Protocol should ensure that no-one can bury evidence of biohazards.

Brazil and globalization

Elisabet Sahtouris, Ph.D. Evolution Biologist/Author/Speaker/Business Consultant. 10588 NE ByronDrive, Bainbridge, WA 98110. Website: <www.ratical.com/lifeweb>; tel: 206 842-6607

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There is much talk these days about globalization — the process by which we are becoming a global society. Global politics and economics can be very confusing, however, and many people wonder whether globalization is a good thing or a bad thing for Brazil.

As an evolution biologist, I have found the best way to see this pattern clearly is to look at our human species and its economic activities as a living system within the larger living system of all nature, or Earth. Scientists are only now discovering that every living system self-organizes and maintains itself according to principles we can identify.

Among these principles — and essential to the health of any particular living system — are the empowered participation of all the system's parts and the continual negotiation of self-interest at all levels of its organization. In your body, for example, every cell and every organ has equal access to resources and equal opportunity to keep itself healthy and contribute to the whole body's well-being. If any cell or organ suffers damage or illness, body resources are mobilized to help it heal itself. Physiologists call this "body wisdom."

If this were not so, and a few organs could prosper by exploiting the others for their own interests, your body would suffer and die. In the same way, a family could not stay healthy if some members got fat eating all the available food while others went hungry.

What has this to do with the economic globalization of humanity? Humanity worldwide is now a single living system like any other, such as a body, family, community, ecosystem, nation or the whole Earth. But in the living system of humanity, we do not empower every human, every city and every nation to share in resources and contribute to the well-being of all humanity.

The globalization of humanity happened over thousands of years of empire-building, from ancient monarchies to modern nations and post-modern multinational corporations. Today it is embodied in the Paris-based Office of Economic Cooperation and Development (OECD) and the World Trade Organization (WTO) it created in Geneva.

On October 1st, Clóvis Rossi, in an article in this newspaper called "Genebra, Paris, Brasilia," stated that the future of all Brazilians is at stake in the policies of the WTO and the Multilateral Agreement on Investment (MAI) presently being prepared by the OECD. He also rightly pointed out that Brazil is not a member of the OECD — for that matter, no country south of Mexico in Central or

South America or anywhere in Africa is a member. In other words, the vast majority of Southern Hemisphere countries are left out of its economic future design process except, in a few cases, as powerless observers.

What they can observe is a global economy designed to further benefit those who are already wealthy while less developed and poorer countries such as Brazil support the process at the expense of domestic self-sufficiency and sovereignty. One year ago, the front page of the *Wall Street Journal* cheered that Brazil would finally be properly mined (now that it belonged to the WTO), though there were still "all those darn trees in the way."

While being in the mainstream of globalization may sound as though Brazil is finally coming into its own, it will actually be increasingly owned and stripped of resources by foreign business, and increasingly dependent on a global economy that is highly unstable and could drag Brazil to ruin.

If Brazil supports the MAI in the upcoming vote, foreign businesses will have better than equal rights with domestic business, including the power to fine Brazil for any infringement on their production process, even if it violates Brazilian environmental and labor standards! This is a highly dangerous situation for the Brazilian people.

Even some of the wealthiest multi-billionaire capitalists in the world now recognize the extreme danger of these economic inequities. As Sir James Goldsmith wrote in the *London Times* of February 1994, "What an astonishing thing it is to watch a civilization destroy itself because it is unable to reexamine the validity, under totally new circumstances, of an economic ideology." And George Soros, in 1997, added "The main enemy of the open society, I believe, is no longer the communist but the capitalist threat."

When the biggest players in the capitalist money markets issue such warnings, we had better pay attention. To call the WTO-ruled commerce "free trade" is worse than a lie, for such labels cover up what these men warn of: a process so inequitable that it now threatens not only Brazil, but the future of all humanity.

So, what can Brazilians do to ensure the growth of Brazil's economy and the well being of the Brazilian people? As I said, a living system must be strong at all levels. The WTO has enormous global power; nations such as Brazil must make their domestic economies equally strong at national and local levels. The ecologically-sound sustainability of Brazil must become a household concept; Brazilian businesses must develop high quality and maximally-recyclable domestic products in every area at competitive prices. The less the reliance on imports, the stronger the nation. And only a strong nation can really compete fairly and effectively in the global economy.

I see in Brazil, beneath a surface lack of confidence that holds it back, an absolutely enormous potential for creativity and dedication. If the media and the educational system would seriously promote sustainable economy and well-being for all citizens as the way to a healthy future — shifting the focus from money to community values, from emphasis on quantity to quality — I know that Brazil could be a powerful leader into a better future for all humanity.

CONFERENCE REPORTS

THE ANNUAL GENERAL MEETING OF THE CANADIAN COMMITTEE OF THE WORLD CONSERVATION UNION (CCIUCN)

Dateline: Ottawa, Ontario,
9 December 1997

Reporter: Alan R. Emery, Ph.D.,
CCIUCN President
(1995–1997)

The mission of the World Conservation Union (IUCN) is "to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable." The IUCN is a large international union of government and non-governmental organizations (NGOs) drawn from more than 135 countries. In Canada, there are a number of strong IUCN connections. The first is the relatively new Montreal Office, which reports directly to IUCN headquarters in Switzerland. Second, as in many countries, Canada also has a national committee. CCIUCN was established in the mid-1980s to support IUCN in its global efforts by coordinating the activities of its member organizations within Canada. In turn, the group also acts to influence IUCN globally. The third connection involves a number of Canadians who either serve on one of IUCN's six Commissions (e.g. Species Survival Commission or Ecosystem Management) or as Regional Councillors.

The recent CCIUCN Annual General Meeting, held at the Canadian Museum of Nature (the location of the secretariat for the CCIUCN), was particularly important. In 1992 the CCIUCN had embarked on a multifaceted campaign to bring Canada more strongly into the IUCN's global efforts and programs. Among the accomplishments of the CCIUCN was the successful invitation of the IUCN to hold its World Conservation Congress in Montreal in 1996. This helped to bring world attention to the role of Canada in conservation. But the CCIUCN reached a decision point; "What role should the Canadian Committee play in support of the IUCN globally?"

At the meeting, the delegates agreed that the complex of Canadian organizations that are both directly and indirectly attached to IUCN should be considered "IUCN Canada." This simple step formally means that CCIUCN members, groups associated with the Montreal Office, the various Canadian representatives on IUCN Commissions, and Regional Councillors will work more closely together in the future, giving Canada a stronger voice and a more coordinated effort.

At the meeting, Malcolm (Mac) Mercer, newly appointed Director of the Montreal Office, highlighted its main focus: the Boreal and Temperate Forest Program, headed by Dr. Andrew Deutz. This global program, approved in 1996, will address severe ecological threats of over-exploitation in certain countries. Mac also described progress in other ongoing IUCN programs in Pakistan and Africa, which the Montreal Office has been managing. In future IUCN Canada will also support an emphasis on programs dealing with water and marine resources.

CCIUCN is especially strong because many of its members are representatives and executives on IUCN Commissions and act as Regional Councillors, and updates were heard from many of these members. Recognizing that the private sector will increasingly control the destiny of our environment in our modern world, a CCIUCN committee had drafted a resolution to include private sector representation within IUCN. Canada's state member, Parks Canada, presented this resolution, which was ratified despite a historical reluctance among IUCN members to include private sector organizations. At the meeting, CCIUCN was pleased to note that the first private sector member to be admitted to the IUCN is from Canada: Centre patronal de l'environnement du Québec.

The role of NGOs as important influences in international policies as well as their roles in local affairs was also highlighted at the meeting. Three presentations were given by the Metro Toronto Zoo (William Rapley), Inuit Tapirisat of Canada (Craig Boljkovak), and Inuit Circumpolar Conference (Terry Fenge).

Finally, there was an election of Officers. Sandy Baumgartner (Canadian Wildlife Federation) is the new President; William Rapley (Metro Toronto Zoo), Vice-President; James McCuaig (Canadian International Development Agency), Treasurer; and Gordon Nelson (Canadian Parks and Wilderness Society), a new Board member. Congratulations!

BIODIVERSITY MEETINGS

17-18 APRIL 1998

The Value of Plant, Animal and Microbial Species to Human Health to be held in New York City, NY, U.S.

Contact: *Central Reservations, American Museum of Natural History, Central Park West at 79th Street, New York, NY, U.S. 10024; Tel: (212) 769-5200; Fax: (212) 769-5292; E-mail: <domroese@amnh.org>; Web site: <http://research.amnh.org/biodiversity/>.*

3–5 MAY 1998

Conserving and Restoring our River Heritage, to be held in Vancouver, British Columbia, Canada.

Contact: *Rene Hogg, Projects Coordinator, Outdoor Recreation Council of BC, 334-1367 West Broadway, Vancouver, BC, Canada V6H 4A9; Tel: (604) 737-3058; Fax: (604) 737-3666; E-mail: <orcbc@istar.ca>*

4–15 MAY 1998

COP-4, the Fourth Conference of the Parties to the Convention on Biological Diversity to be held in Bratislava, Slovakia.

Contact: *CDB Secretariat, World Trade Center, 413 St. Jacques St., Office 630, Montreal, Quebec, Canada H2Y 1N9; Tel: (514) 288-2220; Fax: (514) 288-6588; E-mail: <biodiv@mtl.net>*

25–27 MAY 1998

Le troisième colloque international des spécialistes francophones en évaluation d'impacts, to be held in Montreal, Quebec, Canada.

Contact: *Secrétariat francophone de l'IAIA-AIEI, 380, rue Saint-Antoine Ouest, Suite 3200, Montreal, Quebec, Canada H2Y 3X7; Tel: (514) 288-2663; Fax: (514) 987-1567; E-mail: <iaia@secretariatfranco.org>*

1–3 JUNE 1998

First International Conference on Geospatial Information in Agriculture and Forestry, to be held in Lake Buena Vista, Florida, U.S.

Contact: *ERIM at <http://www.erim.org/CONF/ag.html>*

8–11 JUNE 1998

Ninth Global Warming International Conference (GW9), to be held in Hong Kong.

Contact: *Fax: 1 630-910-1561*

9–20 JUNE 1998

CITES-COP 10 Convention on International Trade in Endangered Species of Flora and Fauna, to be held in Harare, Zimbabwe.

Contact: *CITES Secretariat, 15, chemin des Anémones, CH-1219 Chatelaine, Geneva, Switzerland; Tel: (4122) 979 9139/40; Fax (4122) 797 3417; E-mail: <cites@unep.ch>; Web site: http://www.wcmc.org.uk/CITES/english/enews.htm>*

19–25 JULY, 1998

Introduction to Practical Ecoforestry, to be held at Windhorse Farm in New Germany, Nova Scotia.

Contact: *James W. Drescher, Windhorse Farm, RR2, New Germany, NS, Canada B0R 1E0; Tel: (902) 543-0122; Fax: (902) 543-9950; E-mail: <windhors@fox.nstn.ca>; Web site: <http://www.windhorsefarm.org/new.htm>.*

25–30 JULY 1998

World Congress of Malacology, to be held in Washington, DC, U.S.

Contact: *Rudiger Bieler, President, Unitas Malacologica, The Field Museum, Roosevelt Road at Lake Shore Drive, Chicago, IL, U.S. 60605-2496; Tel: (312) 922-9410 ext. 270; Fax (312) 663-5397; E-mail: <bieler@fmnh.org>; Web site: <http://www.fmnh.org/wcm>*

2–6 AUGUST 1998

Ecological Exchanges Between Major Ecosystems, to be held in Baltimore, Maryland, U.S.

Contact: *Fred Wagner, ESA Program Chair, Ecology Center, Utah State University, Logan, UT, U.S. 84322-5205; Tel: (801) 797-2555; E-mail: <fwagner@cc.usu.edu>*

16–20 AUGUST 1998

Integrated Tools for Natural Resources Inventories in the 21st Century — Inventory and Monitoring of Forested Ecosystems, to be held in Boise, Idaho, U.S.

Contact: *Mark Hansen, USDA Forest Service, North Central Forest Experiment Station, 1992 Folwell Ave, St. Paul, MN, U.S. 55108; Fax (612) 649-5285; E-mail: <hanse034@maroon.tc.umn.edu>*

BIODIVERSITY NEWS

NEW BAMBOO AND RATTAN NETWORK ESTABLISHED IN CHINA

On 6 November 1997 a treaty was signed to establish the International Network for Bamboo and Rattan (INBAR) to be based in Beijing, China. Major funding support for this new research organization comes from the government of China, Canada's International Development Research Centre (IDRC), and the UN's International Fund for Agricultural Development (IFAD). The government of the Netherlands is also expected to contribute. INBAR will be dedicated to studying the potential of bamboo and rattan, two multi-purpose plants, and through its research will address the concerns of food, livelihood, and the environment in developing countries. [Condensed from IDRC press release, 31 October 1997; for more information visit <http://www.idrc.ca/media/index_e.html>]

NIGERIAN TRUST FUND LAUNCHED

On 30 September 1997 the Fund for Integrated Rural Development and Traditional Medicine (FIRD-TM) was inaugurated in Abuja, Nigeria during an international conference on medicinal plants. FIRD-TM has an independent board made up of leaders of traditional healers' associations, senior government officials, representatives of village councils, and technical experts from scientific institutions. Its goal is to build technical skills within Nigeria so that bioresources can become a viable vehicle for sustainable development. Dr. Maurice Iwu, Director of Bioresources Development and Conservation Programme, a Nigerian NGO, said that "The Fund offers an example of how countries, cultural groups, and companies can work together successfully for the benefit of all stakeholders to sustainably develop biodiversity for human health." The Healing Forest Conservancy (an independent non-profit organization founded by Shaman Pharmaceuticals), the Association of Indigenous Pharmaceutical Manufacturers, and the Orange Drug Company of Nigeria all pledged money to support the new fund. [Condensed from BIONET news release, 24 October 1997]

CCD FINDS A HOME IN GERMANY

The Secretariat for the Convention to Combat Desertification (CCD) will be housed in Bonn, Germany, right next door to the Secretariat for the Framework Convention on Climate Change. This decision was made by the first Conference of the Parties held in October 1997. Requests for information may be forwarded to: Interim secretariat CCD, Geneva Executive Center, 11/13 Chemin des Anemones, 1219 Chatelaine, Geneva, Switzerland; Tel: (41-22) 979 9111; Fax: (41-22) 979 9030/31; E-mail: <secretariat@unccd.ch>

15 NEW SPECIES AT RISK

In Spring 1997 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) added 15 species to its list of those at risk in Canada. For the first time the Committee considered butterflies, snails, and mosses. (See "The Neglected Majority Continue to Struggle for Recognition" by B.T. Aniskowicz, *Global biodiversity* 5(3): 4–7). The species that were added in 1997 are as follows:

Extirpated

- Sage Grouse (*Centrocercus urophasianus phasio*), British Columbia
- Karner Blue Butterfly (*Lycaeides melissa samuelis*), Ontario

Endangered

- Maritime Ringlet Butterfly (*Coenonympha tullia nipisiquit*), New Brunswick
- Long's Braya (*Braya longii*), Newfoundland

Threatened

- Sage Grouse (*Centrocercus urophasianus urophasianus*), Alberta and Saskatchewan
- Banff Springs Snail (*Physella johnsoni*), Alberta
- Fernald's Braya (*Braya fernaldii*), Newfoundland
- False Hop Sedge (*Carex lupuliformis*), Ontario and Quebec
- Apple Moss (*Bartramia stricta*), British Columbia

The Pacific Great Blue Heron. Herons sometimes shadow the water with their wings so they can see the fish better. Illus.: Roelof Idema

Vulnerable

- Pacific Great Blue Heron (*Ardea herodias fannini*), British Columbia
- Cultus Pygmy Sculpin (*Cottus sp.*), British Columbia
- Western Silvery Minnow (*Hybognahus argyritis*), Alberta
- Eastern Hognose Snake (*Hetrodon platirhinos*), Ontario
- Monarch Butterfly (*Danaus plexippus*), all provinces
- Fernald's Milk-Vetch (*Astragalus robbinsii var. fernaldii*), Newfoundland and Quebec

You can find the full list of the 291 species at risk in Canada at <http://wwfcanada.org/speclist2.html>. Watch for the 1998 update coming soon.

SUCCESSFUL CHALLENGE TO TURMERIC PATENT

In 1995 the University of Mississippi was granted a patent on the use of turmeric as a healing agent. In October 1996 the Council of Scientific and Industrial Research (CSIR) in New Delhi, India challenged the patent on the grounds that the patent did not satisfy the criteria of "novelty." CSIR provided several studies that documented the use of turmeric in India. In August 1997 the U.S. Patents and Trademark Office ruled that the patent was invalid because it was not a novel invention, based on the evidence of "prior art." [Condensed from *Intellectual Property and Biodiversity News*, Vol. 6, No. 13]

WHAT IS THE FUTURE FOR NATURAL HISTORY MUSEUMS?

A thoughtful and provocative set of essays on natural history museums was published in *Museum News* (Nov/Dec 97), a publication of the American Association of Museums (AAM). The article is entitled "Toward a Natural History Museum for the 21st Century." Leonard Krishtalka and Phil Humphrey will respond to the articles in the March/April 98 issue. The AAM is on the net at: <http://www.aam-us.org>. [From the TAXACOM list serve, November 1997 <TAXACOM@cmsa.berkeley.edu>] The Canadian Museum of Nature is seeking input on its future in the new millenium, too. See "The Last Word" on page 48. [D.E.M.]

BUDGET CUTS AND POLICY SHIFTS

Within the provinces of Ontario and Quebec, budget cuts and environmental policy shifts continue to happen. For example, in 1997–98, the Quebec Ministry of Environment and Fauna (MEF) had its budget cut by 39.2% from 1994–95 figures. Cuts were more substantial within the environment portfolio of the ministry. Of the $357 million in 1994–95, $151 million was for environment and $207 million was for parks and recreation. In 1997–98, approximately $53 million is for environmental protection and $164 million for parks and recreation. The funds for environmental protection were cut $98 million, or 64.9%.

In Ontario, the Ministry of Environment and Energy's budget has been cut 42%, 1000 environmental officers' positions have been eliminated, and funding for environmental groups has been cut while funding for cleaning up beaches, the *Intervenor Funding Project Act*, Environmental Compensation Corporation, and the Environmental Technologies Program have been eliminated.

In addition to budget cutbacks within Quebec, there are also three new policies that have reduced environmental protection capability. The first is the decision not to act on federal environment law in Quebec. In the past, the federal *Fisheries Act* and the Canadian *Environmental Protection Act* (CEPA) have been used effectively by the Quebec Ministry of Environment and Environment Canada to stop gross pollution. Second, the Quebec government has decentralized environmental protection into regions throughout the province. This may present problems when regional governments have to deal with polluters that are also large economic supporters of the region. Third, the province has decided to hand over most of the environmental protection to the polluters. Upon their request, companies have been given the responsibility to police themselves through voluntary environmental agreements. However, the agreements don't follow the basic principles set out for effective voluntary measures. The Quebec Ministry of Environment and Fauna (MEF) web site address is: <http://www.mef.gouv.qc.ca>

In Ontario, the government has issued a notice saying that it "will no longer be providing enforcement of the habitat provisions of the federal *Fisheries Act*" (EBR Registry No. PB7E4004.P, Sec. 35). The government has said it plans to return the responsibility for fish habitat in Ontario to the federal government (at a time when the federal government has also cut its environmental budget by 40%). This move effectively ends the enforcement of the *Fisheries Act* in Ontario. [Condensed from The *Gallon Environment Letter*, Canadian Institute for Business and the Environment, September 8 and November 11, 1997 editions]

CANADIAN MUSEUM OF NATURE GETS MAJOR FUNDING FOR BIODIVERSITY RESEARCH

In November 1997 the Canadian Museum of Nature (CMN) was delighted to announce a three-year $150,000 grant from the EJLB Foundation of Montreal, in support of the biodiversity research project, a "multidisciplinary, community-based study of the environmental health of the Rideau River." In partnership with the Rideau Valley Conservation Authority and local environmental groups, the project began with community consultations in January 1998. The community concerns and local knowledge will feed into the research, slated to start in the spring. The project establishes links with partners outside the museum and the CMN sees this as a great opportunity to get the public involved with science, and scientists involved with the public. The scientific disciplines covered by the project include aquatic plants, phytoplankton/water chemistry, molluscs, amphibians, reptiles, and fishes. Another exciting possibility is the involvement of local high school teachers, who could work the project into their science curriculum.

TROPICAL BIODIVERSITY CONSERVATION CLASSES ONGOING

The University of Costa Rica is now offering an environmental course of study for English-speaking undergraduate students interested in studying the rainforest. The objectives of this program are to introduce the students to the study of tropical biodiversity/natural history, tropical ecology, and conservation biology. The program includes a rigorous field section in tropical ecology and conservation biology. This unique program will give students the opportunity to perform field experiments *in situ* in 7 different tropical habitats within Costa Rica. The cost per semester is now $6,800, including room and board. Three semesters are offered each year. For more information go to: <http://www.neosoft.com/~worldc/cur-prog.htm> or contact T. Jesse Fox, World Class Adventures in Education, 1300 Post Oak 1750, Houston, TX 77056. Tel: (713) 961-3836. Fax (713) 621-9545. E-mail: <Worldc@neosoft.com>. Students receive standard University of Costa Rica credits for taking the course.

NOMINATIONS REQUESTED

The Schultes Award is presented annually by the Healing Forest Conservancy to a scientist, practitioner or organization that has made an outstanding contribution to ethnobotany or to indigenous peoples' issues related to ethnobotany. Specific recognition is given for leadership in partnering with First Nations peoples to bring ethnobotanical knowledge to the forefront in discussions on management of the ancient, temperate forests of the Pacific Northwest with the government of Canada.

Nominations for the 1998 Richard Evans Schultes Award are open until 1 May 1998. For more information, contact Katy Moran, Healing Forest Conservancy, 3521 S Street NW, Washington, DC 20007, U.S.; Fax: (202) 333-3438; E-mail: <moranhfc@aolcom> [From ntfp list serve, 25 Nov 1997]

G7 RAINFOREST PROGRAM IN AMAZON CONTINUES

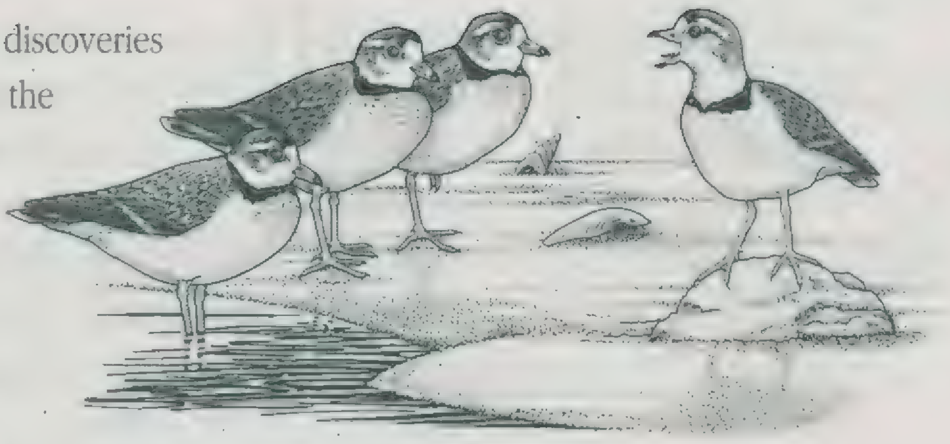
For six years the G7's "Pilot Program" has funded more than 100 varied sustainable development projects in the Amazon. In November 1997, Germany, the U.S., and France agreed to donate $47 million to fund a transition period between the pilot phase and Phase Two of the program, which begins in 2000. Although the exact direction and scope of Phase Two are still to be agreed upon, the aim will be to preserve the Amazonian rainforest as well as the smaller Atlantic forest along Brazil's coastline. More funding pledges are hoped for at the next G7 meeting in Paris in June 1998. [Condensed from Reuters Limited press release, Michael Christie, 25 November 1997]

NICARAGUAN FOREST UNDER DISPUTE

The Awas Tingi of RAAN (the Autonomous Region of the North Atlantic) are suing the Nicaraguan government for handing over a 62,000 hectare forest concession to a South Korean company, Sol del Caribe, in 1996. The government insists the concession was given legally, but the Awas Tingi argue that the concession was given without the consent of RAAN's regional counsel. While they are concerned about the effects of the logging, there is also concern over deforestation due to the advance of the agricultural frontier. According to Alejandro Umaño of the Environmental Movement of Nicaragua, an environmental education program is urgently needed to explain the effects of clearing patches of land within the forest for crops. [Condensed from *Eco-Exchange*, July–August 1997, <infotrop@sol.racsa.co.cr>]

COUNT 'EM! PRAIRIE WETLAND AND POND VIRUSES

Over 2.5 billion viruses were found in one drinking water dugout in Saskatchewan! This is just one amazing statistic from the 300 lakes and wetlands sampled in 1995 by Dr. Richard Robarts of Environment Canada's National Hydrology Research Institute and Dr. David Bird of the University of Quebec in Montreal. Preliminary analysis shows that many of the viruses may be mammalian or avian. Questions remain: Are these new viruses? Do they pose any threats? Are these huge numbers a normal characteristic of prairie ecosystems? [From *EnviroTipsheet*, Issue 142, September 1997] This rivals the similar discovery several years ago of the remarkable numbers of marine viruses. Both discoveries point to the need for the study of viruses from wild species/ ecosystems as opposed to just those of humans or domesticated plants and animals. [D.E.M.]


Piping Plover
Illus.: Roelof Idema

UPDATE ON ACID RAIN

The 1996 annual report for the Eastern Canada Acid Rain Program shows that the seven easternmost provinces in Canada, with the exception of Newfoundland, met their targets to reduce emissions that lead to acid rain. Even in 2010, however, with full implementation of the acid rain programs in the U.S. and Canada, 791,000 square kilometres are expected to receive acid rain in excess of threshold levels. [*Enviro Tipsheet*, Issue 141, 12 August 1997]

On the other side of the globe, Scott Hillis (Reuters Limited, 1997) reports that China's industrial boom is causing acid rain, poisoned oceans, and global warming. China, which burns coal to meet 80% of its energy needs, pumps some 10 million tonnes of sulphur into the air every year, former Australian prime minister Paul Keating told the 1997 China Environment Forum. Sulphur and other pollutants coming from China were at the root of about half of the acid rain that fell in East Asia, Keating said. Tapping foreign environmental know-how is a strategy Beijing is eagerly embracing, with Premier Li Peng calling on overseas companies to help foot the bill for China's huge ecological clean-up. [Condensed from *The Gallon Environment Letter*, Vol. 1, No. 21;.1 December 1997]

PIPING PLOVERS ON THE RISE

The 1996 International Piping Plover Census showed that there has been a 7% increase in numbers since 1991. The biggest regional increase (26.9%) came on the Atlantic coast and is attributed to intense efforts to stop nest predation and human impact as well as maintaining natural habitat formation in Canada and the U.S. [U.S. Geological Survey's Forest and Rangeland Ecosystem Science Centre; Contact: Dr. Jonathan Plissner (514) 758-7761]

In Prince Edward Island, as part of an Environment Canada Action 21 project, volunteers with the Island Nature Trust are working hard to help the endangered birds. They are putting up caution signs, tracking nesting successes, and restoring ten sensitive natural areas. Marram grass is being planted on grass-free paths while native shrubs are being planted in secondary dune areas. [*Enviro Tipsheet*, Issue 141, 12 August 1997]

FIVE YEAR ANNIVERSARY FOR MODEL FORESTS

In May 1997 representatives from the ten model forests across Canada gathered to see what has been accomplished in five years. At the Symposium, held in Winnipeg, Manitoba, it was recognized that there would be a change in direction for most model forests. Criteria and indicators for measuring success in achieving sustainable forest management will be emphasized in Phase II. Funds of $400,000 were allocated to a national model forest to address this issue. An additional $400,000 was dedicated to the development of a national communications strategy by the model forest communication network (MF-C-Net). [From *Horizons*, Fundy Model Forest Newsletter, Vol. 4, No. 3, Spring/Summer 1997]

BOYCOTT ON BC HEMLOCK

B & Q, a British furniture maker, announced a boycott on all hemlock from British Columbia. It intends to switch to pine from Scandinavian forests during 1998. B & Q does not believe that West Coast forest companies will achieve international standards for logging by the end of 1999 — the date it has set for itself to purchase all of its timber and wood products only from Forest Stewardship Council-accredited forests. [Condensed from *The Globe and Mail*, 14 November 1997, A5]

BRAZIL REJECTS TYING TRADE TALKS TO ENVIRONMENT PROTECTION

In November 1997 President Fernando Henrique Cardoso rejected any attempts to tie the environmental protection issues in Brazil to free trade talks. Brazil has long opposed this connection and regards it as an underhanded way of raising the costs of production in less developed countries (i.e. by demanding more expensive ecological standards and minimum workers' rights) and making them less competitive. President Cardoso stressed that Brazil was committed to sustainable development, and said, "We want clear and realistic international commitments on the environment because we won't accept paying the price for other people's economic growth." [Condensed from Reuters Limited, Michael Christie, November 1997]

USING "DESTRUCTOR" ON PCBS

ECO Logic Inc. of Rockwood, Ontario has a new technology called "Destructor" that can be used to clean up polychlorinated biphenyl (PCB)-contaminated sites. The technology turns PCBs into drinkable water, carbon dioxide, methane, and hydrochloric acid. The technology has been used in Australia and Canada. [From *Canadian Geographic*, March/April 1997]

CYBERDIVERSITY

UNEP WEB SITE ON INDONESIAN FIRES

As part of its continuing effort to provide scientifically credible and timely information on the extent of the problem, the United Nations Environment Programme (UNEP) has requested that the World Conservation Monitoring Centre (WCMC) make available on the Internet materials that highlight the potential impact of the fires on the biodiversity of Indonesia — one of the richest in the world. The address for this site is <http://www.wcmc.org.uk/latenews/>. [From the *The Gallon Environment Letter* 1(20)]

DELTA CEASES PUBLICATION

The Canadian Global Change Program of the Royal Society of Canada has announced that it will no longer publish its DELTA newsletter. It will communicate its findings primarily through its Web site: <http://www.cgcp.rsc.ca>. If you would like to be notified of significant new postings on the site, please send an e-mail note to <cgcp@rsc.ca>.

GREENPEACE

To find out what biodiversity issues Greenpeace is working on, visit its web site at: <http://www.greenpeace.org>. The site outlines the campaign work being done to stop terrestrial and aquatic habitat destruction, the over exploitation of species and ecosystems, and the creation and release of genetically engineered organisms.

DOE ENERGY EFFICIENCY STUDY ON-LINE

The United States Department of Energy (DOE) has released a report entitled "Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy-Efficient and Low-Carbon Technologies by 2010 and Beyond." You can access the executive summary of the report and first chapter at <http://eren.doe.gov/carbonstudy/>. The full report is available at <http://www.ornl.gov/ORNL/Energy_Eff/CON444/>.

TAXACOM ARCHIVES BACK ON LINE

After a move to New Orleans, Louisiana, the TAXACOM WWW archive is back on line. The old URL will work for a year, but it is recommended that you change any bookmarks now to: <http://www.biodiversity.uno.edu/mail_archives/taxacom/> [From James H. Beach, U.S. Geological Survey Biological Resources Division]

TROPENBOS SITE

The Tropenbos Foundation, based in the Netherlands, contributes to the conservation of tropical rainforests by promoting their wise use, generating knowledge, and developing methodologies. It also wants to involve local research institutions in these goals and help them increase their capacities. Research sites and projects, publications and themes are on its web site, shared with the European Tropical Forestry Research Network (ETFRN) at <http://www. tropenbos.nl/>.

DISCUSS CONSERVATION, PUBLIC EDUCATION, PUBLIC PERCEPTIONS

Biodiversity Forum, a National Science Foundation-funded site, is designed for people to express and exchange views on topics related to biodiversity loss and conservation. It is designed to serve three complementary objectives:

- Public exchange of opinions related to biodiversity loss and conservation
- Public education about current issues related to biodiversity loss and conservation
- Social science research on public perception of biodiversity loss and conservation

Biodiversity Forum draws upon case studies taken from U.N. Biosphere Reserves. In the United States, many of these Reserves are administered by the National Park Service. Biosphere Reserves featured in November 1997 included Sequoia-Kings Canyon National Parks (as well as the neighbouring Sequoia National Forest) and Channel Islands National Park, both located in California.

The basic principle of Biodiversity Forum is that "everyone has something to contribute and something to learn, whether or not they are experts in biodiversity issues." For further details, please consult the web site at <http://real. geog.ucsb. edu/bioforum> or send an e-mail to: <webforum@geog.ucsb. edu>. You may also contact Prof. Proctor directly at (805) 893-8741 or e-mail him at <jproctor@geog.ucsb. edu>.

ECONOMICS OF BIOLOGICAL DIVERSITY

In September 1997 the IUCN Biodiversity Policy Coordination Division launched a new web site focusing on the economics of biodiversity. Its aim is to provide information and facilitate the sharing of experiences in support of the implementation of the Convention on Biological Diversity. A major feature of this site is its extensive selection of case studies and analyses, which provide insights and lessons about the use of economics for biodiversity conservation.

The site is structured along the following thematic priorities: Incentive Measures, Financial Resources, International Trade, Biodiversity Impact Assessment, Economic Valuation, Natural Resource Accounting, and Private Sector. Of these seven thematic priorities, the first two — incentive measures and financial resources — currently appear to have the highest priority overall for the biodiversity agenda.

The IUCN is most interested in considering your contributions for inclusion on this site. In particular, they are looking for the following items: information on meetings, conferences, workshops; electronic copies of case studies, research papers, reports; notifications and reviews of books, journals, and other publications; and suggestions on links to other sites. The site, at <http://iucn.org/themes/economics_launch/welcome.htm>, is available in three languages: English, French and Spanish.

FIND OUT MORE ABOUT AGRICULTURAL BIOTECHNOLOGY

The Biotechnology Information Center (BIC), one of ten information centres at the National Agricultural Library of the U.S. Department of Agriculture, provides access to a variety of information services and publications covering many aspects of agricultural biotechnology. A search engine allows the quick retrieval of information.

Some of the new bibliographies posted include Biotechnology: Education and Training; Biotechnology: Commercialization and Economic Aspects; Biotechnology: Patenting Issues; and *Bt* (*Bacillus thuringiensis*) Biopesticide Resources. The URL is <http://www.nal.usda. gov/bic/>. Part of the site includes a page of links to newsletters and places to find out the most recent information in this field, and you can reach this list at <http://www.nal.usda.gov:80/bic/Newsletters/>.

EL NIÑO SITE

The El Niño/Southern Oscillation (ENSO) 97–98 site is intended to provide near real-time reports primarily on marine and terrestrial events that may be linked to the development of the 1997 ENSO, which appears to be unfolding as one of the most severe ENSO events in history. Emphasis is on seabirds and changes to marine ecosystems, but it is recognized that other reports may expand the understanding of effects. These might include rainfall, flooding, or associated disease outbreaks. The compilers of the site, Dr. David Duffy and Dr. Peter J. Bryant, will try to be inclusive and let hindsight separate ENSO from other events. The URL is <http://darwin.bio.uci.edu/~sustain/ENSO. html>.

BIOTRADE INITIATIVE

People are invited to visit and contribute to the BioTrade Initiative's web site, developed by the United Nations Industrial Development Organization (UNIDO), the University of Charleston, South Carolina, U.S., and the private sector. The objective of the initiative is to strengthen emerging markets for biological resources as a means of promoting conservation and sustainable development. Two ways of achieving this goal are the web site <http://www.biotrade.org> and an e-mail list. To subscribe to the list serve, send a message to <BiotradeNews@biotrade.org> with the word SUBSCRIBE in the body of the message.

NATURE TREASURES ON-LINE

In the latest update to the Canadian Museum of Nature (CMN) web site, researchers and collections experts present a number of natural history specimens from the CMN collection. Each "treasure" includes information in six main categories: Identification, Distribution, Natural History, In the Collections, Research and Resources, Significance. The posting continues the Museum's thrust to educate the public about the value of collections-based research, and new treasures will be added throughout the years to come. The URL is <http://www.nature.ca/english/treasure.htm>.

NATURE NOTEBOOKS ON SCHOOLNET

Teachers and students, take note. "Natural History Notebooks," a new section on Industry Canada's SchoolNet was launched in spring 1998. The site offers information and illustrations on over 260 species, based on Charles Douglas's "Natural History Notebooks." These notebooks were published in newspapers across Canada in the late 1970s by the Canadian Museum of Nature, and through an Industry Canada program, the Museum is pleased to put these notebooks on-line. The URL is: <http://www.schoolnet.ca/digicol/notebook/english/index.htm>.

CLASSIFIEDS

DIRECTOR

Biological Resources Program, Washington, DC
World Resources Institute, International nonprofit organization, seeks a Director for its Biological Resources Program that has projects on sustainable forestry practices, coastal and marine conservation, agrobiodiversity and ecosystem management. The Director will supervise nine staff members; manage a $1.7 million budget and help obtain funding for the work. The individual selected will have a broad understanding of policy issues related to development and the environment, detailed knowledge and experience working to promote sound biological resource management, and strategic vision regarding the opportunities for policy and institutional change to ensure conservation and sustainable use of biological resources. Requires excellent written and oral communication skills; significant management experience; and an advanced degree and/or 10 or more years of experience. Fluency in one or more languages in addition to English is highly desired. Salary commensurate with experience; excellent benefits. Send resume to Personnel, WRI, 1709 New York Ave., Washington, D.C. 20006; Fax: 202 638-0036. No phone calls.

SINGLES NETWORK

Single science/nature enthusiasts are meeting through Science Connection, a nationwide group. Contact us for info: P.O. Box 599, Chester, NS B0J 1J0; www.sciconnect.com; 1-800-667-5179.

International Interdisciplinary Conference on the Environment (Fourth Annual) — Washington, D.C. from July 7-10, 1998. Abstracts accepted until May 1 by email to <kantard@mindspring.com>. Decisions will be sent immediately. All disciplines invited; grad students welcome. Email for details.

Clean Environment Mutual Funds

For more information on this exciting investment opportunity call, write or fax Geoff Wilkinson at Regal Capital Planners Ltd., 457 Woolwich St., Guelph ON N1H 3X6; Tel: (888) 895-7787; Fax: (519) 823-2790. These mutual funds are RRSP eligible, so call today to find out how to make this year's contribution an environmentally friendly one!

PLACE YOUR CLASSIFIED HERE!
Just $1.50 per word plus applicable taxes (25 word minimum, $37.50). City, province and postal code are free. 10% discount for 2 insertions, 15% for 4 insertions. Phone, fax numbers, and e-mail addresses are one word. Deadlines: Fall issue — July 15; Winter — Oct. 15; Spring — Jan. 15; Summer — Apr. 15. Fax, e-mail, or mail your classified (typed or printed clearly) to: Anne Winship, Ad Manager, Global biodiversity, PO Box 3443, Station D, Ottawa ON K1P 6P4; Tel: (613) 566-4203; Fax: (613) 566-4763; E-mail: <biodiv@mus-nature.ca>.

BOOK REVIEWS

Biopiracy: The plunder of nature and knowledge

By Vandana Shiva. 1997. Between the Lines, Toronto, Ontario. 148 pp, ISBN 0896085554. $13.95.

Can biodiversity and human cultures survive the onslaught of globalized corporate biotechnology? This question is the subject of Vandana Shiva's latest book, *Biopiracy*. In a world increasingly torn by strife and threatened by ecological disaster, the information and analysis in this book carry enormous importance for the future of plant and animal life and of human cultural diversity.

Shiva is one of the most dynamic and original thinkers in the world today, and she doesn't pull any punches. She accuses the big agro-chemical and pharmaceutical corporations of perpetrating thievery and fraud on Third World traditional people and on nature itself. She explains the issues and their inter-connections for the layperson, demystifying concepts like "intellectual property rights" and buzz-words like "bioprospecting." She shows exactly how the provisions of the GATT and other free trade arrangements are undermining sustainable local cultures that have been preserving and enhancing biodiversity for generations. She puts the international Biodiversity Convention and the pious platitudes accompanying it in a whole new light. And her diagnosis of the three stages of globalization — colonialism, development, and free trade — is nothing short of stunning.

Scientist, feminist, and champion of the poor, the author is also a powerful wordsmith, making good use of concepts like "knowledge monoculture," biological "ethnic cleansing," and "biopiracy" to drive home her points and make them memorable. Although she strays at times into academic phrasing, she usually comes quickly back to basics with straightforward logic and concrete examples.

Shiva's brilliant analysis is a beacon to everyone concerned about the vital issues of biodiversity, but she is often rushed or careless in her brilliance, and this means that her work requires substantial editing. Unfortunately, the American publisher who produced this book fell far short of that requirement. The result is an uneven text that reads like a draft, sprinkled with fuzzy definitions, unidentified acronyms, and unclear source references, as well as some confusing sequences, weak explanations, and unsatisfying endings.

Nonetheless *Biopiracy* is well worth reading. Despite the serious editorial flaws, much of the writing is good, the arguments forceful, the concepts and examples fascinating, and the information essential to the struggle. In fact, after the first couple of chapters, the content becomes so compelling that the reader wants to ignore the inadequacies of style and presentation, finish the book and move on to action.

And that is where Shiva leaves us, with a whole stack of reasons (more than we might want!) about why intellectual property rights and free trade agreements must be resisted, and some tantalizing glimpses of how some organizations and people are already doing exactly that. What we need next are coherent plans and strategies for replicating and multiplying that resistance.

We could hardly expect those strategies to be spelled out for us in a 148-page book; besides, by their very nature they will have to be diverse and evolving. But if the global biopirates are to be stopped, the challenge is clear. Wherever we may be on this still-living Earth, we must listen to Shiva's call to action, do our homework, and take it from there.

Helen Forsey, freelance writer and activist, Oompah, Ontario, Canada

Biodiversity, biotechnology, and sustainable development in health and agriculture: Emerging connections

Scientific Publication No. 560 of the Pan American Health Organization. 1996. Washington, DC, ISBN 92-75-11560-5. Paper. 248 pp. US $36.00.

The number of opportunities for commercializing biodiversity taxes one's imagination, as does the unfolding of nature's limitless pipeline of consumer products. This book, however, shows that it will take many years before we see tropical biodiversity tapped for its economic bounty.

Apart from the diversity of products presently drawn from Earth's rainforests, there are other gems whose commercial potential lies hidden by underdevelopment. If the leaders of tropical countries build national structures to make commercial opportunities attractive, will investors come to expedite development and marketing?

This book confirms that the chance to create wealth from biodiversity stands before us — wealth that could propel Second- and Third-World countries to a surfeit of trade with their more prosperous northern neighbours. Sadly, however, we must still ask: is there enough of a playing field to the attract venture capital, corporate alliances, and international business leadership that would compel development of globally attractive products? The answer is firmly, "No."

Is there an action plan among tropical nations that dynamically links investment in commercialization of biodiversity to sustainable economic success for any country? No.

Biodiversity, Biotechnology, and Sustainable Development serves as an education in this field of commercial development. The editors, members of the Pan American Health Organization, have put forward a consistent and well-rounded presentation. There is plenty of information about the tedious policy and legal positions for developing biodiversity economies. But insufficient content has been devoted to exacting *solutions* that will expedite commercialization. (Another shortcoming is the omission of an index.)

INBio, in Costa Rica, where there is a goldmine of potential technologies, is opening up the field, having hosted an international conference on commercial issues in biodiversity in April 1997. Much has been said about the INBio-Merck deal as an example of riches to be gained from biodiversity product development. But the $1 million Merck investment is merely a dribble compared to the cascade that will result when the dams of over-protection, complacence, and over-regulation are breached.

A promising sign of globally effective change in economic planning for commercialization is the evolution of Andes Pharmaceuticals ("A New Model for Biodiversity Prospecting"). Andes is a biotechnology company promising to "invert" previous models of biodiversity development by pumping capital and technology into the source countries, rather than shipping extracts to industry partners for development. This plan preserves specimens without quarantine restrictions, and transfers assets to the host nation early in the development process. Andes's novel, exciting example may just be enough to entice venture capitalists and corporate partners into biodiversity development programs.

Within the decade, we will witness a gold rush in biodiversity commercialization. This book and others like it, outlining policies, ethics, legalities, and resources, are a foundation for product and market development. And if venture opportunities like Andes become successful, the financial world will follow their lead.

Paul M. Gross, PhD, Vice President, Scientific Affairs, CroMedica, Inc., Ottawa, Canada

Restoring diversity: Strategies for reintroduction of endangered plants

Edited by D.A. Falk, C.I. Millar and M. Orwell. 1996. Island Press, Washington, DC. 505 pp. Paper. ISBN 1-55963-297-6, US $27.50.

Restoring Diversity: Strategies for Reintroduction of Endangered Plants is a collection of articles and case histories about the recovery of endangered plant species in the United States through deliberate relocation and related interventions. In many ways, *Restoring Diversity* is a specialized offspring of, and companion to, *Restoration Ecology: A Synthetic Approach to Ecological Research* (by W.R. Jordan III, M.E. Gilpin, and J.D. Ader, 1987, Cambridge University Press). Both these volumes stress the fact that restoration ecology must be approached as an applied science, not as a predetermined set of management recipes. *Restoring Diversity* reflects 10 years of progress in making restoration ecology into a mainstream research program.

This volume was produced in cooperation with the Center for Plant Conservation (CPC), a non-profit organization based at Missouri Botanical Gardens in St. Louis. The CPC is charged with developing programs for the restoration of endangered plant species in the U.S. Many of the field studies in *Restoring Diversity* were conducted under the auspices of this Center.

As a result, a considerable proportion of the book's content is devoted to the regulatory peculiarities of the U.S. *Endangered Species Act* and the functioning of state-specific agencies. Issues that are trans-boundary are given scant treatment. For example, in the chapter "Plant Rarity and Endangerment in North America," Canadian examples are not presented, and there is no mention of the fact that Canadian laws are not the same as American laws.

This omission aside, the theoretical and case-study parts of book are very good. Apparent throughout the book is the current emphasis in ecology on hierarchical patch dynamics. Both spatial and temporal hierarchies must be considered in planning ecological interventions and in identifying goals for those interventions. The case studies are drawn from a variety of habitats and species. The book gives the sense that there is financial support for this sort of work in the U.S. However, it is apparent that the authors draw primarily from their experiences working with government regulations and priorities.

Restoring Diversity was the result of a deliberate focus by the CPC on the process of reintroduction. It records the empirical results (successes and failures) of moving individual organisms with the intent of rehabilitating populations. Restoration ecologists should pay particular attention to the experiences of formal mitigation related in this volume. A complex American regulatory structure has been built on the assumption that mitigation works. But entrenching mitigation as a routine management activity begins with the faulty premise that development is a better use of land than leaving the existing biotic fabric intact. The empirical evidence presented here shows that in many cases the destruction of a rare habitat cannot can be successfully offset by deliberate attempts to recreate the habitat elsewhere.

We highly recommend this book. *Restoring Diversity* is a national case study in endangered species recovery — it details the specifics of plant reintroduction programs and the experiences of individual projects.

David A. Galbraith and Jeremy Lundholm, Science Department, Royal Botanical Gardens, Hamilton, Ontario, Canada

Canada and the state of the planet: The social, economic and environmental trends that are shaping our lives

Michael Keating and the Canadian Global Change Program. 1997. Oxford University Press, Toronto, Ontario. 110 pp. ISBN 0-19-541246-X. $14.95.

This is the first important Canadian work on the global environment and, more specifically, on the major global socioeconomic and environmental problems that challenge Canadians today. It is a small bedside book that covers the information essential to understanding the major trends of today and tomorrow.

Six distinguished Canadians wrote the first part: Michael Keating, Maurice Strong, James P. Bruce, Jacques Prescott, Mary Simon, and Hugh Morris. These authors help us understand the nature of ozone layer depletion, global warming, biodiversity loss, etc. The authors analyze the human and natural factors responsible for these global changes, as well as the effects that they may have on the environment, the economy, our political and social systems, and human life. They also offer possible solutions to these problems.

The second part of the book deals with contemporary trends, explains why and how the global environment is changing and emphasizes the major environmental trends: global warming, ozone layer depletion, atmospheric pollution, erosion and degradation of the soil, deforestation, the slowness of Canada to protect areas, water pollution, and loss of biodiversity. The few dozen pages of this chapter are an excellent report on the current state of the environment. The conclusion deals with the means to reverse these trends, using a process that would lead to a lifestyle that respects the environment — a lifestyle called "sustainable development."

The third part of the work, entitled "Context and References," provides useful information on the transition to this kind of permanent society. Chapter 11 describes the evolution of the planet and the current state of the environment in Canada, with numbers to prove the point.

The book also contains an environmental chronology from the Industrial Revolution to the present, a list of resources at the federal and provincial levels, a list of national, international, non-governmental and academic organizations, and a list of web sites. A short bibliography, with suggested readings and an index make up the rest of the book.

In short, we have here a beautifully crafted and valuable instrument well adapted to environmental education and sustainable development. This work is well illustrated; many pictures, graphs, maps and tables make for easy reading.

Jean-Guy Vaillancourt, Department of Sociology, Université de Montréal, Montreal, Quebec, Canada

Restoring nature's place: A guide to naturalizing Ontario parks and greenspaces

By Jean-Marc Daigle and Donna Havinga. 1996. Co-published by Ecological Outlook Consulting and Ontario Parks Association. 226 pp. Soft cover, ISBN 0-9681018-0-1. CND $49.00.

This guide is a highly useful and informative publication that deals with the techniques of converting "managed landscapes to more natural and naturally evolving landscapes relatively free of long-term human intervention." The authors recognize that there are no ready answers for the many types of naturalization projects that could be undertaken throughout the province. Each region has a unique combination of species, soils, climate, topography, hydrology, and cultural history. Consequently, they focus on providing practical information on the ecological and theoretical underpinnings behind the naturalization process and establish the basic approach that should be followed in undertaking such a project, whether at the landscape or local site level.

The publication is divided into four sections. The first deals with the natural and cultural history of Ontario, thereby firmly rooting this publication within a provincial context. The next section details, step by step, how to develop an action plan. The third section focuses on three broad ecosystems in Ontario. These include freshwater ecosystems (riparian communities, wetlands, riverine habitats, and lakeshores), forest ecosystems, and open areas represented by meadows and tall-grass prairies. The authors review the salient factors in understanding the make-up and functioning of these natural systems and present some approaches that can be followed in their naturalization. The fourth section deals with the challenge of educating, organizing, and working with people to ensure positive results and continued commitment to a project.

In the nine chapters (in a relatively small typeface), the authors pack in a great deal of information, always setting the scene by providing the ecological or philosophical context to the subject. Numerous text boxes highlight supplementary information such as on existing restoration projects and monitoring projects, and ecological or biological facts and principles. The text is amply illustrated with line drawings and black and white photographs. The latter would be improved had a higher quality, less ecologically-minded paper stock been used. The references and resource documents cited at the end of each chapter provide an extensive listing of informative publications. A comprehensive appendix consisting of a native plant table of woody and herbaceous plants with their special requirements is a particularly useful resource. Other appendices provide listings of organizations, demonstration projects, videos, and policy and legislative considerations related to the topic.

Although clearly set within an Ontario context, the basic framework for action documented in considerable detail can be applied to any project, regardless of political or biophysical boundaries. The publication is likely, however, to be of greatest value within Ontario because of the numerous and highly specific references and examples provided. The guide would be a valuable resource text and primer for managers of public spaces and could serve as a basic text on the subject for ecology and landscape architect students. Any groups wishing to undertake the naturalization of community green spaces would do well in beginning their project with a review of this informative primer.

Erich Haber, Research Associate, CMN, National Botanical Services, Ottawa, Ontario, Canada

Betrayal of science and reason: How anti-environmental rhetoric threatens our future

By Paul R. Ehrlich and Anne H. Ehrlich. 1996. Island Press, Washington, D. C. 335 pp. Paper. ISBN 1-55963-297-6, US $27.50.

Paul and Anne Ehrlich have been tracking population growth, global warming, ozone depletion, and reduction of biodiversity for 30 years and in the process they have become perceptive and persuasive commentators on the looming environmental crises. In *Betrayal of Science and Reason* the Ehrlichs take aim at those who have turned against the warnings of environmental scientists, exploding one "brownlash" myth after another, giving even the most ideological anti-environmentalist reason for pause. The "brownlash" is a collection of wide-ranging grievances. Some cast the environmental movement as a collection of special-interest groups driven by ideology. Some denounce it for applying the brakes to national productivity. Other opponents see government action on behalf of the environment as inimical to individualism. At the most sophisticated level, some claim there are no objective facts, no environmental science in the true sense, and other data, other sciences, can demonstrate that there is no crisis.

The enemies of environmentalism claim that environmentalists lack balance — that they do not sufficiently recognize the plurality of goods (economic profit, consumer power, private property rights, martial supremacy) that individuals legitimately pursue, favouring one good — the environment — and demanding unconditional attachment to it from all of us.

While acknowledging that there are many human goods, the Ehrlichs insist that a secure, healthy environment — understood as a complex self-correcting and self-reparative interplay of natural processes — is the *sine qua non* of any human life at all.

The Ehrlichs devote the largest part of their study to marshalling evidence countering anti-environmental myths. They are particularly persuasive when they point out the rational fallacies used to ridicule environmentalism. For example, apparent disagreement among atmospheric scientists about the extent of global warming is interpreted to mean that the phenomenon is essentially contestable. Sophistic arguments, such as the claim that dioxins pose no health risk because natural occurrences like forest-fires produce dioxins at no substantive risk to the environment are exposed.

The Ehrlichs do not limit themselves to rebutting the environmental critics. "Sustainable development," "wise use," "population and poverty control," and the effective translation of scientific evidence into everyday language are some of the solutions the Ehrlichs put forward. The 1993 statement by 58 scientific academies supporting a consensus in interpretation of the hard data on the deterioration of the environment serves as an appendix and should be mandatory reading.

A modest criticism that one might level against the Ehrlichs' otherwise highly commendable book is that their arguments concentrate on bringing the weight of scientific evidence against the foolishness of ideologues, a good writing strategy since often it is opinion-brokers and ideologues who have the greatest impact on public perceptions. But there are also credible philosophical objections to the environmental movement that are not addressed. The very strength of the environmental case, that we must stop seeing ourselves as lords and masters of nature, is potentially its Achilles heel. It may, taken to an extreme, push us to assimilate ourselves so totally with the natural world that we forget that human greatness — in art, culture, rational capacity — is built on the surplus, leisure, and freedom made possible by the conquest of nature. Were it not for modern science, economic productivity, and excess wealth, most of us would still be labouring in the natural world, and subject to its unrelenting and unredemptive cycle of growth, decay, and death.

Peter C. Emberley, Carleton University, Ottawa, Ontario, Canada

Biodiversity, science and development: Towards a new partnership

Edited by F. Di Castri and T. Younès. 1996. CAB International - IUBS. Paper. ISBN 1-55963-483-9. US $24.95.

The 1988 publication of *Biodiversity* (edited by E.O. Wilson and F.M. Peter) and the 1992 signing of the Convention on Biological Diversity at Río have in many ways galvanized the scientific community in a new effort to understand the Earth. What are the biophysical functions of the planet as a whole? How do the dynamics and structures of its ecosystems and biota interact and affect each other? How can humankind deal with its expanding influences, superimposed on an intricate tapestry of increasing global change?

This volume records presentations and debates that took place at a September 1994 forum in Paris within the framework of a cooperative scientific program on biodiversity entitled, *DIVERSITAS*. The program was launched in 1991 under the sponsorship of the International Union of Biological Sciences (IUBS), the Scientific Committee on Problems of the Environment (SCOPE), and UNESCO.

The book begins with governments' messages from both industrialized and developing countries, as well as the views of UNESCO, UNEP, ICSU, and IUBS. It moves on to discuss the science of biodiversity including mechanisms, function, and change. The next section addresses the integration of the more practical aspects of biodiversity management and the basic conceptual framework of conservation biology. Uses of biodiversity in agriculture, grazing and forestry; aquaculture and fisheries; and industry are discussed, as is the impact of these sectors on biodiversity. The book goes on to consider biodiversity in urban and peri-urban environments, and the cultural and ethical dimensions of biodiversity.

The range of the topics reflects the multi-stakeholder interests in and controversy over the conservation and sustainable use of biodiversity. The book is a valuable source of information, not only for specialists but also for members of the conservation community, those in the private sector, politicians, and other decision-makers — in short, to anybody in the spectrum from which participants to the Forum were drawn. It should help to fulfill a key objective of the Forum — to build bridges of understanding between various perspectives.

Five years after the signing of the Biodiversity Convention at Rio, it is appropriate to distill a few of the messages in this book that contribute effective approaches and facts that will help implement the Convention. The reader gains an appreciation of the underlying causes of biodiversity loss — human population growth, high per capita consumption, market forces, military activities, and the cumulative impacts of all these factors. Resulting habitat destruction and fragmentation lead to reduced biodiversity and create barriers to gene flow, which in turn adversely affects ecosystem functions and their capacity to respond to environmental change.

That said, what are some of the key economic, sociopolitical, and ecological measures that will form part of an overall strategy to balance the attention given to loss of biodiversity with concern for sustainable use of harvestable species? Suggested measures include providing information based on the best available science to groups such as farmers, ranchers, and foresters to demonstrate the real benefits of conserving biodiversity; devolving management responsibility and tenure rights to the communities most directly involved; and ensuring that prices fully reflect the costs of environmental goods and services.

This book is timely and should help to bring the scale of political decisions in line with the scale of change occurring in nature. Hopefully, this will lead to policy changes that will ensure the sustainable and equitable use of biodiversity.

Ken R. Lum, UICN, Montreal, Quebec, Canada

Les Cahiers de l'Association pour la protection des invertébrés

(APPI) no 1, Spring 1997 (Notebooks of the Association for the protection of invertebrates)

This new publication raises debate concerning the protection of biodiversityby focusing on invertebrates. The publication attempts to cover regional and national issues (that is, within France), as well as other matters that may have international significance in the protection of invertebrates and their habitats. The first issue (Spring 1997) studies diversity and environmental roles of invertebrates as well as the reasons justifying their protection. It also studies the environmental impact of a reduction in invertebrate diversity, with special attention to the human consequences. It is therefore useful to review such background information before addressing the main issues in this matter.

Despite its regional focus, this publication will inform amateur and professional scientists, as well as the general public and politicians, about the state of the environment and the consequences of a reduction in invertebrate populations. Vertebrates all too often get all of the attention. While avoiding an alarmist attitude, this publication will inform the stakeholders on matters that don't always make the headlines. Except for some Internet sites where there is some discussion on this topic, there are few publications that adopt such an interactive approach to safeguarding of the environment.

It is a little early to predict how successful the Cahiers de l'APPI will be, particularly in regards to their capacity to cover a wide diversity of topics (including the use of invertebrates in the food industry, interactions with introduced exotic species, urban development, etc.). Still, this initiative is a great step towards recognition of the role and impact of invertebrates in our everyday life.

Jean-Marc Gagnon, Ph.D., Chief manager, Invertebrate collections, Canadian Museum of Nature.

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North American range plants (5th edition). J. Stubbendieck, S.L. Hatch and C.H. Butterfield. 1997. University of Nebraska Press. 501 pp. Paper, ISBN 0-8032-9243-0. US $25.00.

Nature's services: societal dependence on natural ecosystems. Gretchen C. Daily ed. 1997. Island Press. 416 pp. Paper, ISBN 1-55963-476-6. US $24.95.

Kinship to mastery: Biophilia in human evolution and development. Stephen R. Kellert. 1997. Island Press. 240 pp. Hardcover. ISBN 1-55963-372-7. US $25.00.

Insects of the Yukon. Hugh Danks. 1997. Biological Survey of Canada. Distributed by Entomological Society of Canada, 393 Winston Ave., Ottawa, Canada, K2A 1Y8. 1034 pp. Hardcover, ISBN 0-9692727-8-2. Cdn $95.00 (includes shipping).

Quand l'océan se fâche: histoire naturelle du climat. Jean-Claude Duplessy. 1996. Éditions Odlie Jacob, 15, rue Soufflot, 75005, Paris. 277 pp. Paper. ISBN 2.7381.0417.7. 140 F.

Beyond the Ark: Tools for an ecosystem approach to conservation. W. William Weeks. 1997. Island Press. 173 pp. Paperback. ISBN 1-55963-393-X. US $20.00.

Conserving vitality and diversity: Proceedings of the World Conservation Congress Workshop on Alien Invasive Species. IUCN. Compiled by Clayton D.A. Rubec and Gerry O. Lee. 1997. Published in partnership with the IUCN Species Survival Commission and the North American Wetlands Conservation Council (Canada). Canadian Wildlife Service, Environment Canada. Paperback. 96 pp. ISBN 0-662-25402-3.

Plants, people and culture: The science of ethnobotany. Michael J. Balick and Paul Alan Cox. 1996. The New York Botanical Garden/Scientific American Library, New York. 228 pp. Hardcover, ISBN 0-7167-5061-9. US $35.00.

Biomimicry: Innovation inspired by nature. Janine M. Benyus. 1997. Morrow. 256 pp. ISBN 0-688-13691-5. US $25.00.

Behavioural approaches to conservation in the wild. Janine R. Clemmons and Richard Buchholz (eds). 1997. Cambridge University Press. 382 pp. Paperback, ISBN 0-521-58960-6. US $ 29.95.

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Strengthen, integrate, and balance core objectives

There is a great deal of merit in the traditional museum functions of acquiring knowledge (systematics research, specimen identification), preserving the record (collections and data care), and sharing that knowledge (exhibitions, educational programs, print and electronic media). These vital services should be supported.

There are also new ways to fulfill these core objectives. These include engaging the public directly in generating and sharing knowledge, thereby creating a legacy of lasting benefit to a community. These and other new ways should be explored with a view to building upon existing strengths.

Deliver relevant national service

Because of its national mandate, the CMN has a unique role to play in creating and maintaining networks of expertise in science and in museology. It is also the natural science museum best positioned to act for Canada internationally, drawing on its networks to develop responses and initiatives as appropriate.

Develop enduring partnerships and programs with other organizations that have similar interests

All science museums and scientific agencies share concerns about fulfilling mandates, missions, and responsibilities from a reduced resource base. The CMN should use this common concern as a basis for exploring new ways of working together in order to create optimum public value.

Encourage a healthy organizational culture

Staff are the most important resource and asset in this public enterprise. The Museum should identify and implement ways of strengthening, encouraging, motivating, developing, and acknowledging this essential group of individuals. It also needs to find ways to ensure that all institutional work is carried out with full benefit of their individual and collective brainpower, skill, and energy.

Establish a diversified and stable financial base

The CMN should identify and implement ways to attract new sources of support for mission-critical areas of activity and service.

These then are the six institutional initiatives identified in our assessment and planning process to date. I welcome your thoughts and perspectives concerning the areas to be considered or addressed in order to enable the Canadian Museum of Nature to make its most substantial contribution to addressing the crisis in biodiversity.

Joanne DiCosimo

Joanne DiCosimo
President and CEO
Canadian Museum of Nature
P.O. Box 3443, Station "D"
Ottawa, ON K1P 6P4
E-mail: <jdicosimo@mus-nature.ca>

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THE LAST WORD

Towards A Natural History Museum for Canada in the 21st Century

The impending millennium and society's transition into the 21st century hold special significance for the large museums of natural history created in previous eras. At the most fundamental level, natural history museums — providers of biosystematic knowledge, keepers of the natural record — are wrestling daily with the ever-growing crisis in biodiversity and the diminishing resources available to confront the crisis. All are engaged, therefore, in planning and assessment processes aimed at ensuring that available resources are directed to support those areas where they can make their greatest contributions. The Canadian Museum of Nature (CMN) is no exception. The CMN is engaged in defining its role for the 21st century and I invite the readers of *Global biodiversity* to assist us in this process.

Whether or not you are a Canadian resident, I am sure that you can envision the institution's circumstances and its challenges. The Canadian Museum of Nature holds a vast taxonomic collection of plants, animals, minerals, and fossils (over 10 million specimens), which have been acquired or amassed over a 150-year period. Our scientists and collections staff have worked concertedly to build and interpret this record of the natural environment. Our science educators have worked equally concertedly to use the knowledge derived from the collections and research to generate understanding of and concern for the natural world in which we all live. There have been many achievements and many successes over time. However, when we at the Museum consider the crisis in biodiversity and contemplate the apparent lack of public concern about this crisis, we have to ask ourselves if we are taking the most effective steps to bridge the gap. Are we using our traditional strengths in collections, research, and education in ways that have maximum impact and create optimum public value? What more can be done? And, within that, what is the unique contribution that a national museum of the natural sciences can make in addressing the biodiversity crisis?

In order to consider these questions, the Museum conducted a national consultation with the museum and scientific communities in six Canadian cities as well as within the institution in the fall of 1997. The messages, impressions, and advice gleaned from this process have been invaluable, and this consultation process is the beginning of what will be an ongoing dialogue with Canadians about their national natural history museum. The consultation results indicate that six fundamental initiatives should be the CMN's focus as we move from this millennium into the next. I invite your advice and comments on these six initiatives.

Focus on issues of concern to Canada

The CMN should concentrate on issues shared across the regions of this vast country — issues that others with more localized interests and mandates cannot contemplate. To do so, it must build a network of concern as well as a network of resources and bring these to bear on addressing the problems held in common. Then a comprehensive response can be developed.

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A few words about the Canadian Museum of Nature

The origins of the Canadian Museum of Nature (CMN) were formed within the Geological Survey of Canada in 1842. Over 150 years later, the CMN has some 10 million specimens in its collection, which still represents only half the known species in this country, and an active team of scientists, collection managers, education specialists, and business experts.

The CMN's mandate is to increase knowledge and understanding of, appreciation and respect for, and interest in the natural world. This role has never been more crucial, as the demand for environmental harmony between the world's burgeoning human population and nature reaches a critical point. For more information about the Museum's activities, please contact Joanne Charette, Corporate Communications at (613) 566-4249.

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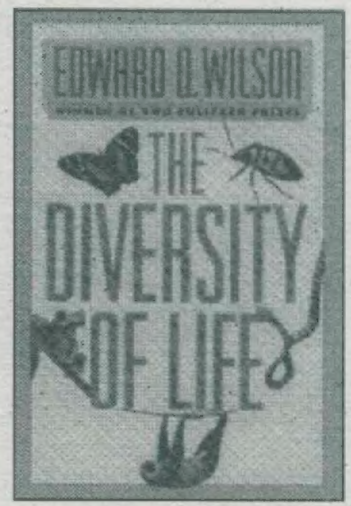

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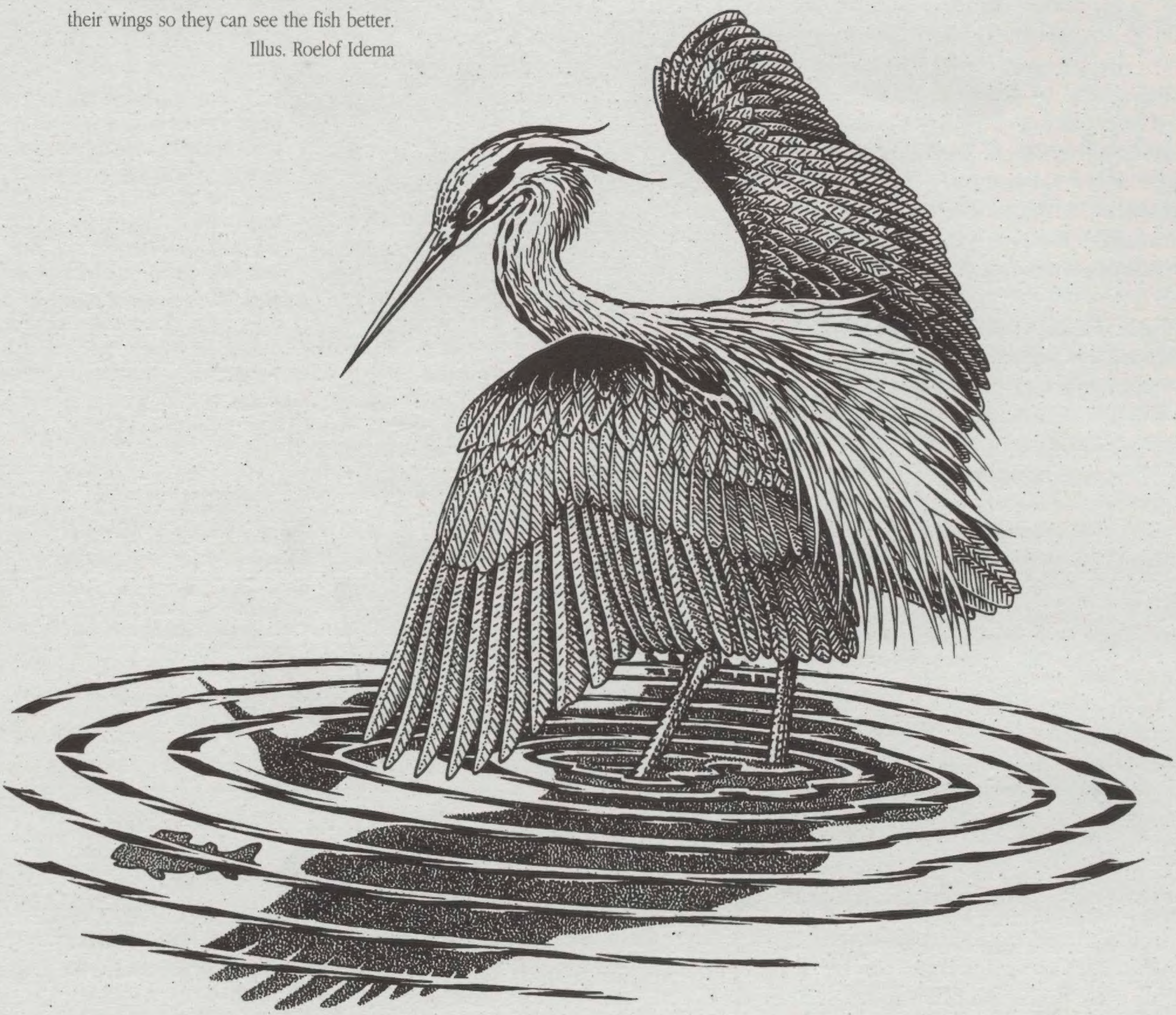
(now "vulnerable" in BC).
Herons sometimes shadow the water with
their wings so they can see the fish better.
Illus. Roelof Idema



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